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DEPARTMENTS

DEPARTMENT OF DEFENSE

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REDUCTION IN PAPERWORK
RIP

Article on page 27 by Mr. Clyde Bothmer, Executive Secretary, Defense Industry Advisory Council, covers actions being taken by the Defense Department and other interested organizations to reduce the paperwork burden on defense contractors and subcontractors.

Army Materiel Command To Reorganize Subordinate Units

Secretary of the Army Stanley R. Resor has approved an Army Materiel Command reorganization that will affect four subordinate units.

The shuffle calls for the phase out of the U.S. Army Mobility Command at Warren, Mich. As a result of the deactivation, the Mobility Command's three operating units, the Army Tank-Automotive Center, Warren; the Army Aviation Materiel Command and Army Mobility Equipment Center, both in St. Louis, Mo., will become separate elements reporting directly to Army Materiel Command headquarters in Washington, D.C.

Of the 180 civilian employees of the Army Mobility Command about 170 will be absorbed by the Army Tank-Automotive Center. The others will be offered positions with the Army Aviation Materiel Command, the Army Mobility Equipment Center, or with other subordinate elements.

The reorganization schedule, which calls for the deactivation of the Mobility Command by January 1967, began Aug. 1 when the Army Aviation Materiel Command and the Army Mobility Equipment Center became individual commands under their previous commanding generals.

When the transition is complete, the Army Tank-Automotive Center will be re-established as the Tank-Automotive Command under the direction of Major General W. W. Lapsley, who now heads the Mobility Command. Brigadier General W. J. Durrenberger, present Army Tank-Automotive Center commander will become Deputy Commander of the Army Tank-Automotive Command.

Air Force Reorganizes Tactical Air Command Centers

An Air Force reorganization of Tactical Air Command centers has resulted in the establishment of a Tactical Airlift Center at Pope AFB, N. C., and establishment of a Tactical Fighter Weapons Center at Nellis AFB, Nev. The new centers will minimize temporary assignment of personnel and equipment which are not available for normal mission during temporary duty periods.

The Tactical Airlift Center is collocated with an airlift wing at Pope AFB and next to the Army's XVIII Airborne Corps and the 82nd Airborne Division at Fort Bragg. This location will aid coordination of Army and Air Force testing of equipment and the development of tactics and techniques used in transporting and resupplying Army and Air Force troops by tactical aircraft.

At Nellis AFB the new Tactical Fighter Weapons Center will be the agency which will identify problem areas, test new equipment and develop new combat tactics for tactical fighters. Combat crew training and fighter weapons school classes presently conducted at Nellis will continue under the supervision of the center.

Under the reorganization of the centers, the Tactical Air Reconnaissance Center, Shaw AFB, S. C., will expand operational testing and evaluation of tactics and equipment used in tactical reconnaissance aircraft. At Eglin AFB, Fla., the Tactical Air Warfare Center will continue tests and evaluation of combat-improving projects which require specialized facilities of the Air Force Systems Command available at the base. No change is contemplated in the Special Air Warfare Center.

DEFENSE INDUSTRY BULLETIN

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The purpose of the *Bulletin* is to serve as a means of communication between the Department of Defense (DOD) and its authorized agencies and defense contractors and other business interests. It will serve as a guide to industry concerning official policies, programs and projects, and will seek to stimulate thought by members of the defense-industry team in solving the problems that may arise in fulfilling the requirements of the DOD.

Material in the *Bulletin* is selected to supply pertinent unclassified data of interest to the business community. Suggestions from industry representatives for topics to be covered in future issues should be forwarded to the Business & Labor Division.

The *Bulletin* is distributed without charge each month to representatives of industry and to agencies of the Department of Defense, Army, Navy and Air Force. Requests for copies should be addressed to the Business & Labor Division, OASD(PA), Room 2E813, The Pentagon, Washington, D.C. 20301, telephone, OXford 5-2709.

Systems Analysis and Cost Effectiveness

by
Russell Murray II

I am not enough of a historian to speak authoritatively as to the exact moment when systems analysis techniques were introduced into the defense business. But it is clear that the kind of questions addressed by systems analysis activities have been around for some time. For example, in Richard Hough's book, "Dreadnought," there appears the following extract from a report by Lieutenant Commander Sims to President Theodore Roosevelt at the turn of the century, concerning American battleship construction policy:

> **"The final conclusion is, that for the sum that it would cost to maintain the twenty small battleships, we would maintain a fleet of ten large ones that would be greatly superior in tactical qualities, in effective hitting capacity, speed, protection, and inherent ability to concentrate its gunfire, and have a sufficient sum left over to build one 20,000-ton battleship each year, not to mention needing fewer officers and men to handle the more efficient fleet."**

Though battleship construction policy is not our problem today, the whole tone of that quotation—the framing of the issue, the relationship between cost and effectiveness—has a remarkable ring of familiarity for today's systems analyst.

With the advent of World War II, the demand for activities in the general area of systems analysis grew sharply, and the groundwork was laid for its growth in the post-war period. Though the area of interest in World War II was narrowed by the urgencies of the situation, the intent was really no different than it is today. At that time, the emphasis was naturally on maximizing the effectiveness of existing forces; whereas, in the post-war era, the analysis could consider longer-ranged alternatives with significant differences in cost implications. Systems analysis began to expand from considerations of what we could do with what we had on hand at the moment to what we could do with what we might elect to have on hand in the future. Throughout this period, assuring the efficient utilization of resources in the DOD became progressively more difficult as a result—to coin a phrase—of mushrooming technology. The bewildering array of entirely feasible alternative forces which our scientists can offer today has enormously complicated our problems of choice. There is hardly a military task which cannot be accomplished in a multitude of ways—and many capabilities which we take for granted today have been wholly impossible over most of the span of military history. We cannot hedge against this array of possibilities by simply buying them all. To attempt to do so would only lead to squandering of resources on partially completed programs. Choices have to be made, and the aim of systems analysis is to help in making those choices correctly.

Just what systems analysis consists of is difficult to put into a few words, for it really is a blend of many things, and it draws on many of the formal disciplines. We do find, however, that economics is one of the most useful of the disciplines, since the core of systems analysis work centers on the economic problem of the efficient allocation of resources. Charles Hitch and Roland McKean, in their book "Economics of Defense in the Nuclear Age," had this to say on the subject:

Russell Murray II serves as Dep. Asst. Secretary of Defense for General Purpose Programs (Systems Analysis). Mr. Murray, who has worked as a missile flight test engineer, joined DOD in 1962 as a consultant. Before assuming his present post in December 1965 he was Dep. Comptroller for General Purpose Forces.

> **"The economic problem is to choose that strategy, including equipment and everything else necessary to implement it, which is most efficient (maximizes the attainment of the objective with the given resources) or economical (minimizes the cost of achieving the given objective) — the strategy which is most efficient also being the most economical.**
>
> **"Strategy and cost are as interdependent as the front and rear sights of a rifle. One cannot assign relative weights to the importance of the positions of the front and rear sights. It does not make sense to ask the correct position of the rear sight except in relation to the front sight and the target. Similarly one cannot economize except in choosing strategies (or tactics or methods) to achieve objectives. The job of economizing, which some would delegate to the budgeteers and comptrollers, cannot be distinguished from the whole task of making military decisions."**

Much of the systems analysis work in the Defense Department utilizes an approach that is familiar to the economist. Nonetheless, it also involves considerations familiar to the engineer, the mathematician, the statistician and other professions. But one thing which it does not do is substitute for the decision maker. On the contrary, the whole aim is to present the decision maker with the clearest possible picture of what his choices really are—what each will do, when it will do it, and what it will cost. It also attempts to point out the uncertainties—to show what it would mean if uncertain key assumptions were changed, and to give a feeling for which factors are critical and which are not. To sort out those issues, to bring them into the open, to establish a forum for discussion along orderly lines, systems analysis has been found a useful tool in the Defense Department.

Systems analysis was formally introduced in DOD in 1961 when Charles Hitch, formerly the head of the Economics Department at The Rand Corporation, was appointed Comptroller. Within his organization, a systems analysis office was established at the level of a directorate. In 1962, this group had expanded and its

head, Dr. Alain Enthoven, was appointed a Deputy Assistant Secretary of Defense. With additional demands being placed on this group, and with analysis being applied to an increasingly wider scope of the Defense activities, in 1965 the systems analysis office, together with the existing cost estimation facility, was split from the Comptroller's office and established as a new office at the level of Assistant Secretary of Defense—this level, of course, reporting directly to the Secretary of Defense.

The Office of the Assistant Secretary of Defense (Systems Analysis)—OASD(SA)—is organized into five sections: one for strategic programs; a second for general purpose programs; a third for resource analysis (including cost estimation and manpower requirements); a fourth for economic analysis; and a fifth for command, control, communications and intelligence.

The office is closely integrated with other activities within the Office of the Secretary of Defense. For example, for expert advice and analysis of technological matters, we rely on the Office of the Director of Defense Research and Engineering. For matters relating to production scheduling possibilities and procurement policies, we rely on the Office of the Assistant Secretary of Defense (Installations and Logistics). And, of course, we work very closely with the Services and the Joint Chiefs of Staff. I would like to refer briefly to this relationship.

A portion of the analytical work done in DOD does take place within OASD(SA) proper. However, by far the largest fraction of the analytical effort is conducted by, or under the aegis of, the Services and the Joint Chiefs of Staff. In any program as overwhelmingly large as that of DOD, the opportunities for analysis are far beyond the physical capacity of OASD(SA), and our function is not to conduct all, or even an appreciable fraction, of the analyses that affect our defense planning. Rather, one of our major functions is to suggest to the Secretary of Defense those areas in which analysis would be profitable, i.e., areas adapted to analysis. The Secretary then considers our recommendations and, from time to time, requests the Services or the Joint Chiefs of Staff to conduct analyses. At that point, our function becomes one of working closely with the study organizations. If we can, we will work with the groups in selecting proper figures of merit and criteria, and we will try to help with the choice of assumptions. Above all, we will try to make sure that the analyses are directed along lines which will be responsive to the Secretary's needs.

In some instances, these analyses will be conducted by the military staffs. In others, they will be contracted out to organizations such as Rand, the Center for Naval Analysis, the Research Analysis Corporation, or the Institute for Defense Analysis. Though not all studies require it, it is generally at this stage that inputs of various kinds are solicited from industry and, in some cases, industry may conduct specialized studies for the various Services. I will have more to say later about the role I believe industry can play in this process.

When these studies are submitted to the Secretary of Defense, OASD(SA) participates in their review. In this function, we examine the studies in detail, and inform the Secretary as to our feelings as to their validity, what new information has been uncovered, what that implies for the future, and what we would recommend in that light—with respect both to changes in defense planning and the need for any further analyses.

I think you should be able to appreciate from this that the use of systems analysis techniques in DOD has come of age. It now has become a way of life; its influence can be very great, and often is. But before I leave this point, let me hasten to add that although the value of such techniques has been recognized and accepted, their limitations have not been forgotten. Every person who works with or makes use of systems analysis techniques in the Office of the Secretary of Defense—including the Secretary himself—is aware of the limitations. It might be worthwhile mentioning four of the more important ones.

• **First, analytical techniques are not a panacea.** There will always be considerations which bear on the very fundamentals of national defense which are simply not subject to any sort of rigorous, quantitative analysis. It is not even possible to draw a line between those which are and those which are not—the gamut encompasses a wealth of considerations which are more or less subject to analysis. Thus, there will necessarily be questions which lie outside the scope of our analytical technique. For this reason alone, we cannot expect a panacea. But even if an entire issue cannot be resolved through analysis, it is important to realize that every bit which can be confidently analyzed and interpreted removes one more bit of uncertainty from the process of making a choice.

• **Second, because of the esoteric aura surrounding the word "analysis," coupled with the fact that analyses are conducted by human beings with human failings, the use of analytic techniques presents us with a potential hazard, as well as a potential benefit.** I do not consider this a valid reason for dismissing the utility of analyses, for the hazards of non-analysis are far greater. But it does indicate that the approach to analysis must never be casual—it is a tool of great power, and it must be treated with respect.

• **The third point is that systems analysis involves as much art as it does science.** As an example, there is no standard method of evaluating the military worth of a tactical aircraft on a relative basis. This is not to say that we cannot make such comparisons, but that there is no single correct way. Accordingly, it is inevitable that judgment is involved in determining how the analysis shall be conducted. The art of analysis requires many talents and, as any art, it is perfected only through experience.

• **Finally, on the fourth point, the state of the analytical art is in an early stage of development, and it is only recently that the use of analytical techniques has begun to have a major effect on our defense structure.** At present, we have far more questions which are amenable to analysis than we have experienced analysts to work on them. But groups of analysts are being formed and gathering experience in places where none existed before. In addition to the well established centers for analysis—some of which I mentioned earlier—many military contractors have such groups as part of their organizations, though my experience is that they often report at too low a level to have a real impact. I might note in that connection that the real benefit of a systems analysis facility can be realized only if it

is located next to the decision maker, where it can be responsive to his needs and aware of his problems. We find this to be the case in the Office of the Secretary of Defense, and I see no reason why it should not be equally true elsewhere.

On the other hand, I would not not want to give you the impression that systems analysis techniques are useful only at the highest levels. It is equally useful to decision makers on all levels as well as during all the chronological stages in the development of weapon systems. After all, what this sort of activity attempts to do is to reduce the uncertainties involved in making choices between alternatives. It is clear that choices are necessary not only for the user of military hardware, but also for the supplier—the prime contractors, the subcontractors and even the component specialists.

Furthermore, choices must be made continually as any given weapon system is developed, not only the basic decison to embark on the project, but later as the "paper" design is translated into hardware; still later, how to employ the system to best advantage and, in many cases, how to modify the system to take advantage of new technology or to extend its useful service life.

Thus, with choices to be made on all levels on a continuing basis, and not just at the "top," it is clear that the opportunities for benefiting from analytical techniques are extremely wide. It is for this reason that the generation of additional numbers of qualified analysts and further development of the art of analysis holds so much promise.

I would like to conclude by addressing the role that industry can play in this process, and I can think of at least three possibilities.

The first concerns a problem that we run into at the very earliest stages in the genesis of a new weapon system. Too often in the past, the requirement for a new weapon system has been stated in terms of rigid performance specifications. For example, the "requirement" will state that a new aircraft must have some specific payload, range, ceiling and speed capability; it must carry particular kinds of equipment which weigh just so much and do certain things; it must weigh no more than a certain specified amount, and so on. This sort of rigid performance specification may well be useful, or even essential (though I have more to say about this later) when the problem is to move one particular system into the hardware stage. But there is a very different problem which should be settled first: to select one particular system from among all the alternative systems which could also accomplish the specific military task. Before we can even get to the contract definition phase, we need to analyze and compare the alternatives, and this requires a far greater scope and flexibility than that provided by a rigid performance specification.

In the future, as in the past, the genesis of a weapon system will be marked by, and depend on, a bright idea in somebody's head. We will never find a substitute for that, though analysis can help guide our thoughts to where the bright ideas are waiting. The subsequent task is to subject the bright idea to the test of analysis in the form of a study, probably conducted under the auspices of one of the Services. At this point, what is needed is something which I believe industry is, or should be, ideally suited to provide: a catalog, if you will, of the kinds of alternative systems which could be made available. I do not mean a catalog without limits. Just how wide a range of alternatives that catalog should encompass would be determined by the Service organization reponsible for the systems analysis. That same organization would also have to decide how many different industrial firms should be solicited for such catalogs, and whether that should be done on a contracted basis.

On each page of that sort of catalog would be a description of one particular alternative: how long it would be before we could have it in service; some estimate of the technological risks involved; what its performance characteristics would be (including not only such things as range, speed and payload, but also reliability and maintainability); what its costs would be—to develop, to produce and to maintain and operate. Let me hasten to add that, at this stage in the development of a new system, the emphasis would be on covering a wide range of alternatives rather than on examination in detail.

Conventional design procedures leave much to be desired for this sort of activity. If each of a wide range of alternative systems has to be laid out in detail, with every nut and bolt in place, the time and cost involved in developing such a catalog would be prohibitive. What is needed, instead, is the development of new techniques for parameterized design. In this respect, my impression is that the aircraft manufacturers are ahead of most of the rest of industry. They use a technique called "rubberized design" which allows them, without even getting near to a drafting table, to stretch or shrink the various characteristics of a new aircraft design this way and that—increasing or decreasing the take-off distance, the range, the payload, the speed, finding out what this means in terms of size or gross weight, and so on—and doing this all on a rapid and, I might add, surprisingly accurate basis. It has taken time to develop this facility, and I would like to see it applied more widely for such catalog-building purposes. In addition to the rapid prediction of technical characteristics, a similar facility is needed for the prediction of costs. Both depend, of course, on historical analyses of earlier systems. A good deal of effort is now going into this sort of work, as I am sure you are aware, and I cannot overemphasize to you its importance to us.

The role that potential prime contractors would play in this building of catalogs is fairly clear—they would describe possible types of aircraft, ships, missiles and other major systems. The role played by the supplier of components, on the other hand, would seem to me to be in support either of the prime contractor or of the Military Service responsible for the systems analysis, with the component supplier's role becoming increasingly important as the gross characteristics of the new system begin to evolve.

The concept behind this development of catalogs is to allow a rational analysis of the alternatives. Before we can decide whether we should simply modernize the systems we already have, or whether we should build new ones, and, if so, what their characteristics should be, we need to know what the choices really are. We use systems analysis to help decide among these alternatives, or to suggest even better ones, but we cannot begin to apply

(Continued on Page 22)

New Navy Procurement Planning System Makes Government Business More Attractive

by
Capt. Joseph L. Howard, SC, USN

Defense contractors doing business with the Navy can look forward to more expeditious award of clearly defined contracts. Through increased emphasis on better procurement planning, Navy business will become more attractive to defense contractors. This will be made possible through the Navy's new Advance Procurement Planning System (APPS).

The keystone of the new APPS is the integration of contract considerations into the early weapon system planning cycle. The new system rests on two key principles: First, earlier procurement planning, intimately linked with early program planning; and second, a shift of responsibility for procurement planning from the supporting staff officials (contracting officers) to the actual system acquisition manager.

Under APPS the hardware manager must broaden his planning efforts to include not only the usual engineering and logistics aspects, but also the economic and contractual aspects. He must focus his attention not only on the final product but on how it will be obtained in the market place. Thus, the weapon systems planners are not planning in an "ivory tower" but are proceeding with a practical eye toward what they want and how they will get it most effectively and economically through the medium of the contract.

The trouble with the old approach, Vice Admiral I. J. Galantin, Chief of Naval Material said, is that engineering and logistic plans are greatly influenced—even thwarted, in extreme cases—by eventual purchasing requirements, over which the manager has little control. Conversely, purchasing may be "locked in," made inflexible, by engineering decisions made in a vacuum. As a result, the eventual contract may be advantageous neither to the contractor nor the Government.

To correct this, the Navy intends to introduce procurement considerations much earlier, even in the R&D planning phase and concept formulation phase, and is publishing procedural guidelines to be sure that it is done.

The new APPS does not affect the Navy's organization at all—it's just a matter of the same people doing the same things at different times. The Navy contracting Officer will, for example, begin thinking about the contractual approach much earlier in the weapon acquisition planning process. Likewise, the program planner will be thinking from the outset about the contract document as the medium through which he clearly communicates his requirements to the contractor.

The new system also reduces administrative procurement leadtime through the concurrent consideration of both technical and procurement factors—and by combining internal approval and procurement planning procedures.

The implications to defense industry suppliers are significant. The reduction in administrative procurement leadtime means that industry can look forward to earlier consummation of contracts. For example, contractors competing in contract definition (CD) will have a broader indication of what the Government visualizes in the program, both in terms of the requirement itself as well as the type of contractual arrangement contemplated. Contract terms could be worked out during the competition phase of CD and give a more complete basis for source selection. Carried to its ultimate, selection of source could be immediately followed by signing what is already a definitive instrument insofar as each competitor is concerned.

Capt. Joseph L. Howard, SC, USN, a veteran Navy Supply Corps officer with 26 years service, serves as Asst. Chief of Naval Material (Procurement) and Director of Procurement, Office of Asst. Secretary of the Navy (Installations and Logistics). He is author of a newly published book titled "Our Modern Navy."

Participation in Navy contracts will also be more attractive because the new APPS gives developers a better chance at first production runs. APPS also is aimed at stimulating more competition initially for contract awards. Coupled with the developer/first production approach is a safeguard to assure that technical data are adequate to facilitate competitive procurement for later follow-on production.

Timely advance procurement planning will also increase competition through greater use of two-step formal advertising, rather than negotiation, as a method of procurement. In a similar manner, the new system will make possible the increased use of life-cycle contracting and, thereby, help reduce maintenance and supply costs.

The gains for defense contractors from this more precise and comprehensive kind of program planning are many. Reduced administrative leadtime means more timely contracts. Better planning means clearer requirements spelled out in contracts. Source selection becomes easier. Developers will have a better chance for first production business. Competition will be improved among qualified companies. Technical data, a perpetual problem, will be more clearly defined. Improvements in contracting methods, such as two-step formal advertising and multi-year procurement, will be routinely exploited by plan rather than by helter-skelter "add-ons" in the late procurement stages.

To the defense industry, the Navy's new APPS means more attractive business opportunities that lend themselves to better planning for the utilization of plant capacity. Vice Admiral Galantin confidently expects that both members of the Defense-industry team will benefit. Industry will gain from more orderly planning—the Navy will obtain better material, sooner for less.

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Townsend Hoopes has been appointed Principal Dep. Asst. Secretary of Defense (International Security Affairs) succeeding **Adam Yarmolinsky**, who is leaving Government service.

VAdm. Kleber S. Masterson, USN, has turned over command of the U.S. Second Fleet to **VAdm. Bernard A. Clarey** and assumed the post of Director, Defense Weapons Systems Evaluation Group.

Maj. Gen. William T. Smith, USAF, became Chief of Staff, Defense Communications Agency Aug. 1, succeeding **Brig. Gen. James H. Weiner,** USAF, who has retired.

Maj. Gen. Ethan A. Chapman, USA, has been reassigned as Commanding General, Western Region, NORAD, headquartered at Hamilton AFB, Calif. He relieves retiring **Maj. Gen. Andrew R. Lolli, USA.**

Brig. Gen. John D. Crowley, USA, succeeds **Brig. Gen. Raymond C. Conroy,** USA, as Commander, Western Area, Military Traffic Management and Terminal Service, Oakland, Calif.

Brig. Gen. Thomas L. Hayes, USAF, has been appointed to the post of Dep. Commander for Management and Systems, Military Traffic Management and Terminal Service.

Col. Joel B. Stephens, USA, has assumed the position of Director for Community Relations, Office of Asst. Secretary of Defense (Public Affairs). He replaces **Col. Julian B. Cross,** USAF, deceased.

Capt. Frank Larsen, USN, has been appointed Chief, Office of Industrial Security, Defense Contract Administration Services (DCAS), Defense Supply Agency. He succeeds Col. **James S. Cogswell,** USAF, who has been designated as Special Assistant to the Dep. Dir. for DCAS.

Col. Theodore Antonelli, USA, has been named Dir. of the Office of Research & Systems, Military Traffic Management and Terminal Service.

Col. Leon Stann, USAF, has been designated Dep. Commander, Defense Fuel Supply Center. He has been serving as Acting Commander since the hospitalization of **RAdm. Winston H. Schleef,** SC, USN.

Capt. Robert R. Campbell, SC, USN, has been named Dep. Commander, Defense Electronics Supply Center, Dayton, Ohio.

Capt. Carl J. Stringer, SC, USN, is the new Dep. Commander, Defense Supply Depot, Mechanicsburg, Pa.

Col. Paul A. Legg, USAF, has been assigned as Dir., Office of Planning & Management, Defense Electronics Supply Center, Dayton, Ohio.

Col. George D. Mobbs, USAF, has been named Dir. of Value Engineering, Office of Asst. Secretary of Defense (Installations & Logistics).

Col. Milton Frank, USAF, has been named Chief of Public Affairs for the North American Air Defense Command. He takes over for **Col. Harold Woodruff, USAF,** who is retiring.

DEPARTMENT OF THE ARMY

Maj. Gen. Robert F. Seedlock has been named Dir., Military Construction, in the Office of the Army Chief of Engineers. He succeeds **Brig. Gen. John C. Dalrymple,** who has been reassigned to the Office of the Dep. Chief of Staff (Logistics), Dept. of the Army.

Maj. Gen. Roland B. Anderson, Commanding General, Army Weapons Command, Rock Island, Ill., has been reassigned to the Office of the Asst. Secretary of the Army (Installations & Logistics) as Dir., Army Procurement.

Former Dir. of Army Research **Maj. Gen. Walter E. Lotz Jr.,** has returned from duty in Vietnam to become Chief of Communications-Electronics, Dept. of the Army.

Brig. Gen. Horace G. Davisson, recently nominated for a second star, has been assigned as Dep. Commanding General, Army Weapons Command, replacing **Brig. Gen. Charles M. Prosser** who will retire from the Army.

Brig. Gen. James A. Hebbeler is the new Dir. of the Chemical-Biological-Radiological and Nuclear Operations in the Office of the Asst. Chief of Staff (Force Development), Department of the Army.

Brig. Gen. John K. Boles Jr., has assumed new duties as Dep. Commanding General, Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

Dr. **George W. Howard** has retired as Technical Dir. of the Army Research & Engineer Research and Development Laboratories, Fort Belvoir, Va., ending a 35-year military civilian career.

Col. John S. Chambers Jr., became Commanding Officer of Picatinny Arsenal, Dover, N.J., upon retirement of **Col. Henry W. Wishart.**

Col. Harry L. Bush has assumed command of the Army Aviation Materiel Laboratories, Fort Eustis, Va., succeeding **Col. John L. Klingenhagen.**

The following staff assignments within the Office of the Chief of Research & Development, Department of the Army, are announced:

Col. Robert K. Moore has been appointed Chief, Air Mobility Div., Development Directorate; Col. **John E. Kuffner** has been appointed Chief, Nuclear, Chemical-Biological Div., Missiles & Space Directorate; Col. **George Sammett Jr.,** has been appointed Executive, Office of the Chief of Research & Development; **Col. John F. Kuznicki** has been appointed Chief, Review & Analysis Div., Plans & Programs Directorate.

DEPARTMENT OF THE NAVY

RAdm. Charles E. Loughlin has been assigned as Commandant, Naval Dist., Washington, D.C.

Capt. Martin D. Carmody has been assigned as Project Manager for the REWSON Project, Naval Material Command.

Capt. Burton H. Andrews has been reassigned as Dep. Dir., Laboratory Programs, Navy Material Command. He previously served in the Office of the Dir. of Defense Research and Engineering.

Capt. Charles W. Griffing, has been named Commanding Officer, U.S. Navy Space Systems Activity, Headquarters, Air Force Space Systems Div. (AFSC), Los Angeles, Calif.

Capt Lawrence Lovig Jr., SC, is the new Asst. Dep. Chief of Naval Material (Logistic Support).

Capt. Walter F. Mazzone, has taken over as Officer-in-Charge, Submarine Systems Project Technical Office, Navy Submarine Support Facility, San Diego, Calif.

Capt. Donald C. Stanley has been assigned as Commanding Officer, Naval Weapons Evaluation Facility, Kirtland AFB, N.M.

DEPARTMENT OF THE AIR FORCE

Lt. Gen. **Thomas P. Gerrity,** Dep. Chief of Staff, (Systems & Logistics), U.S. Air Force, has been assigned additional duty as Senior Air Force Member, Military Staff Committee of the United Nations.

Maj. Gen. Jack J. Catton, Dir., Aerospace Programs, U.S. Air Force, has been assigned additional duty as Asst. Dep. Chief of Staff, (Programs & Resources).

Brig. Gen. Horace D. Aynesworth has been reassigned as Dep. Dir. of Operations, (AFLC), Wright-Patterson AFB, Ohio, from duty as Asst. to the Dep. Chief of Staff (Plans & Operations), U.S. Air Force.

Col. Ralph A. Johnson has reported to Robins AFB, Ga., as Warner-Robins Air Materiel Area Director of Procurement and Production.

Col. Henry J. Mazur is the new Chief of the U.S. Strike Command System Program Office (492L) for the Electronic Systems Div. (AFSC), L. G. Hanscom Field, Mass.

Col. David V. Miller became Vice Commander, Space Systems Div. (AFSC), Los Angeles, Calif., Sept. 1.

Translation of Today's Ideas into Tomorrow's Aerospace Weapon Systems

by
Maj. Gen. Marvin C. Demler, USAF

The life expectancy of our nation in the decades ahead will depend on the success of translating ideas into new and improved aerospace weapon systems. The rapid application of ideas to the next generation of systems is a life-blood necessity for preserving the security of the free world in the international race for survival. Effective use of creative ideas hold the key to the future.

Translation of ideas into new weapon systems is the mutual concern of both the Air Force and industry. The Air Force Systems Command (AFSC) is responsible for advancing aerospace technology by acquiring the best possible aerospace systems for the nation. However, tomorrow's weapon systems cannot become a reality without industry's assistance. Industrial ideas are melded into Air Force needs by the Research and Technology Division (RTD) of the Air Force Systems Command.

In July 1962, RTD was established as a major step toward the improved management of Air Force research and development resources. Formation of the division resulted in strengthening the Air Force in-house laboratories by creating a broad base of military technology for timely application in systems development.

Initial action in the establishment of RTD was the consolidation of 30 small, scattered Systems Command laboratories into eight major Air Force laboratories and the Systems Engineering Group (SEG). The field organizations were regrouped by technical area under RTD to strengthen the Air Force in-house research and development capability and provide a focal point for information on all technological progress in industry, universities and research organizations (Figure 1).

The division assures effective coupling with the industrial and scientific community through the operation of Area and Host Scientific and Technical Liaison Offices (STLO's) strategically located in the United States, Canada and the Canal Zone. Area STLO's establish and maintain liaison with research and development organizations in a wide geographical zone but the coupling efforts of host offices are limited to activities at the assigned installations (See STLO listing on page 27).

The responsibility for providing laboratory support to existing and future systems through the AFSC systems divisions also assures that RTD is knowledgeable of all systems needs. RTD's close contact with the AFSC systems divisions facilitates rapid translation of ideas into weapon systems.

RTD functions like a computer by accepting diverse technical ideas and providing rapid read out of technology into a framework of meaningful exploratory and advanced development programs. The division manages, through its eight laboratories and SEG, 1,250 technical efforts with more than 8,000 research and development contracts at a total value in excess of $1.5 billion.

A major RTD objective is providing effective team leadership in using the nation's total scientific and technical resources in development of weapon systems. The division's range of interests in scientific and technical innovations has unlimited horizons, extending wherever there are ideas. The wide open RTD antenna is receptive to ideas from any person or organization associated with technology, particularly industry. What, then, is required to promote maximum cooperation for channelling valuable innovations from the bench scientist to the Air Force for quick application to existing and new weapon systems?

Maj. Gen. Marvin C. Demler, USAF, Commander, Research & Technology Div., Air Force Systems Command, has held key positions in the Air Force research and development program since being commissioned in 1938. Prior to his present assignment he was Director of Advanced Technology, Hq., USAF.

Maximum cooperation can begin with the widespread dissemination of Air Force requirements. In response, industry can evaluate its work in the research and development spectrum to select ideas for submission to the Air Force. RTD functions as a reception desk for ideas. Numerous methods are readily available for coupling industrial ideas to Air Force needs.

Knowledge of Air Force technical needs is essential for effective marketing of any innovation. Each year a series of Technical Objective Documents (TOD's) is prepared by Air Force laboratories identifying Air Force technical problem areas requiring the assistance of science and industry. Broad technical guidance not normally available elsewhere is contained in these documents to assist in research and development planning and submission of unsolicited proposals. The guidance includes significant information on specific program objectives, existing state of the art, technical forecast, and the responsible laboratory project officer for direct personal contact.

Any qualified organization in the scientific and industrial community with a research and development capability may request the documents. Requests for participation in the TOD Release Program should be submitted to Headquarters, Research and Technology Division.

Technical guidance on Air Force needs is also presented at numerous conferences during the year. For ex-

ample, early in 1966 the Commander, RTD, emphasized to defense contractors and potential contractors complete Air Force needs. He was part of a team which presented factual information on defense planning, policies and probable developments at the Advanced Planning Briefings for Industry at Boston, Atlanta, St. Louis, San Francisco and Washington, D.C. Large groups of management officials, research scientists and marketing experts from the entire spectrum of large and small business concerns attended the briefings sponsored by the Defense Department and the National Security Industrial Association.

RTD is a fisher for scientific and technical ideas through advance publication of future technical requirements in the U. S. Department of Commerce "Business Daily." A review of these synopsized requirements permits a rapid response to the RTD line of interests.

The RTD open house program of lectures and demonstrations provides an opportunity for attendees to become better acquainted with the division's key personnel, technical programs, capabilities, special equipment, facilities and support of systems divisions. The open house, originally designed for Government scientists, engineers and research and development administrators, has been expanded to include aerospace industries and university officials. The eyeball-to-eyeball contact at the lectures and demonstrations encourages industrial representatives to return home and evaluate their own laboratory efforts for possible application to Air Force needs.

Speeches by the Commander, RTD, and Dr. Leon Green, Jr., RTD Scientific Director, often emphasize technical areas of interest. Key speeches and presentations are frequently designed to trigger a response from industry with new and better ideas for the next generation of weapon systems.

RTD operates like a miner, descending into many laboratory veins in the nation focusing the Air Force headlamp to uncover ideas for use in weapon systems. Accordingly, the Air Force sponsors and co-sponsors many technical symposia each year in exploratory and advanced development program areas which attract a wide variety of scientific and engineering personnel across the country. The division has emphasized professional improvement programs for its key laboratory and management personnel which have included attendance at technical symposia. Attendance at the specialized symposia, such as the Annual Symposium on Space and Ballistics Missile Technology and the Materials Symposium provides unlimited opportunities for the exchange of new ideas with representatives of professional societies, industry and universities. Invitations to the technical symposia can be obtained from the professional societies sponsoring the event.

Publication of the *Research and Technology Briefs* magazine is a major division effort of identifying for industry in-house research and development efforts in progress. The *Briefs*, published each month as an unclassified document, contains scientific and technical articles, papers by leading Air Force laboratory personnel and a calendar of key scientific and engineering symposia and meetings. Research organizations may be placed on distribution for the *Briefs* by submitting a written request to RTD headquarters.

(*Continued on Page 27*)

Research and Technology Division
Air Force Systems Command
Bolling AFB, Washington, D.C. 20332

Rome Air Development Center Griffiss AFB, N.Y. 13442	Surveillance Technology—Intelligence Collection and Processing Reconnaissance Data Handling — Communications — Computer Technology—Data Presentation—High Power Electromagnetic Technology.
AF Aero-Propulsion Laboratory Wright-Patterson AFB, Ohio 45433	Turbine Engines—Ramjet Engine Propulsion—Electric and Non-Chemical Advanced Propulsion Concepts—Power Generation Fuels and Lubricants—Aerospace Support Techniques.
AF Avionics Laboratory Wright-Patterson AFB, Ohio 45433	Navigation and Guidance—Reconnaissance Techniques — Aerial Surveillance — Laser Techniques—Electron Devices and Processes—Electromagnetic Warfare—Electromagnetic Environment—Aerospace Data Transmission.
AF Flight Dynamics Laboratory Wright-Patterson AFB, Ohio 45433	Structures — Flight Mechanics — Flight Control—Vehicle Dynamics—Environmental Control—Aerospace Vehicle Mechanical Systems—Recovery and Crew Station.
AF Materials Laboratory Wright-Patterson AFB, Ohio 45433	Structural Materials—Environmental Resistance—Materials for Seals, Sealants and Compliant Applications—Materials for Electromagnetic Applications—Materials for Energy Conversion, Transfer and Storage.
AF Weapons Laboratory Kirtland AFB, N.M. 87117	Nuclear Weapons Components—Biophysical Studies—Nuclear Power Applications —Environment Research—Nuclear Weapons Effects Research, Testing and Simulation.
AF Rocket Propulsion Laboratory Edwards AFB, Calif. 93523	Propellant and Combustion Technology—Liquid Rocket Technology—Solid Rocket Technology—Nuclear Rocket Technology —Aerospace Ground Equipment Technology—Rocket Propulsion Facility Technology.
AF Armament Laboratory Elgin AFB, Fla. 32542	Conventional Munitions—Chemical-Biological Technical Development—Target and Scoring Techniques.
Systems Engineering Group Wright-Patterson AFB, Ohio 45433	Systems Engineering and Technical Direction for Aeronautical Systems—Study and Analysis Support for AFSC and Other Government Agencies—Procurement Services for USAF Laboratories at Wright-Patterson AFB.

Figure 1.

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SEPTEMBER 1966

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OCTOBER 1966

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27	28	29	30			

NOVEMBER 1966

SPEAKERS CALENDAR

DEPARTMENT OF DEFENSE

Maj. Gen. W. T. Smith, USAF, Chief of Staff, Defense Communications Agency, at Armed Forces Communications and Electronics Assn., St. Louis, Mo., Oct. 7.

Mr. B. B. Lynn, Dep. Dir., Defense Contract Audit Agency, at the National Contract Management Assn., Boston, Mass., Oct. 7; at the Long Island Chapter, National Assn. of Accountants, Long Island, N.Y., Oct. 18; at the National Assn. of Accountants, Chicago, Ill., Nov. 4; at the Electronic Industries Assn., Government Procurement Relations Dept., Colorado Springs, Colo., Nov. 17.

Lt. Gen. H. C. Donnelly, USAF, Dir., Defense Atomic Support Agency, at World Affairs Council Meeting, Pittsburgh, Pa., Nov. 17.

DEPARTMENT OF THE ARMY

Gen. Frank S. Besson Jr., Commanding General, U.S. Army Materiel Command, at Advance Planning Briefing for Industry (appearance only), Rock Island, Ill., Sept. 27.

Maj. Gen. Keith L. Ware, Chief of Information, at Association of the U.S. Army Annual Meeting, Sheraton Park Hotel, Washington, D.C., Oct. 10-12 (appearance only); at Eighth Annual Honors Luncheon of the Army Aviation Assn. of America, Shoreham Hotel, Washington, D.C., Oct. 14 (appearance only).

Brig. Gen. Lloyd B. Ramsey, Dep. Chief of Information, at Annual Assn. of the U.S. Army Meeting, Sheraton-Park Hotel, Washington, D.C., Oct. 10-12 (appearance only); at Reception by Army Aviation Assn. of America, Shoreham Hotel, Washington, D.C., Oct. 14 (appearance only).

Col. Thomas O. Blakeney, Director, Materiel, Army Combat Developments Command, Fort Belvoir, Va., at Advanced Planning Briefing for Industry, Rock Island, Ill., Sept. 27 (panel member).

DEPARTMENT OF THE NAVY

Hon. Paul H. Nitze, Secretary of the Navy, at Institute of Electrical and Electronic Engineers Annual Convention, Washington, D.C., Oct. 3; at Navy League Dinner, New York City, Oct. 26; at Navy Day Celebration, Charleston, S.C., Oct. 27.

Hon. Robert H. B. Baldwin, Under Secretary of the Navy, at National Maritime Union Convention, New York City, Oct. 4; at Propeller Club, Washington, D.C., Oct. 5; at Navy Day Luncheon, New Orleans, La., and Navy Day Dinner, Naval Air Station, Pensacola, Fla., Oct. 27; at Civil Service Board of Advisors Dinner, Pensacola, Fla., Oct. 28.

Admiral David L. McDonald, Chief of Naval Operations, at Propeller Club, Washington, D.C., Oct. 5; at Foreign Services Institute, Washington, D.C., Oct. 12; at Industrial College of the Armed Forces Meeting, Norfolk, Va., Nov. 3.

VAdm. I. J. Galantin, Chief of Naval Material, at Defense Weapon Systems Management Center, Wright-Patterson AFB, Ohio, Oct., 7; at American Management Assn., Washington, D. C., Oct. 17.

RAdm. H. A. Renken, Commander Service Force, Atlantic, at Sixth Regular Convention of the Navy League, Pompono Beach, Fla., Oct. 7.

Mr. Paul R. Miller, Asst. for Quality Control, Special Projects Office, at Region Two Conference of American Institute of Engineers, Atlantic City, N.J., Oct. 13.

Adm. Thomas H. Moorer, Commander-in-Chief, Atlantic Fleet, at Navy League & Kiwanis Club, Richmond, Va., Oct. 24; at Navy Day Luncheon, Philadelphia, Pa., Oct. 27.

DEPARTMENT OF THE AIR FORCE

Gen. J. P. McConnell, Chief of Staff, USAF, at Defense Orientation Conference, Washington, D.C., Sept. 30; at American Ordnance Assn. Meeting, Los Angeles, Calif., Oct. 5-6; at International Congress of Air Technology, Hot Springs, Ark., Oct. 28.

Hon. Robert H. Charles, Asst. Secretary of the Air Force (Installations and Logistics), at Institute of Government Contracts, Dallas, Tex., Sept. 30.

Hon. Norman S. Paul, Under Secretary of the Air Force, at National Space Club, Washington, D.C., Oct. 18.

Maj. Gen. H. B. Manson, Commander, Air Force Flight Test Center, Edwards AFB, Calif., at Trade Club Meeting, Bakersfield, Calif., Oct. 19.

Brig. Gen. L. A. Kiley, Commander Air Force Missile Development Center, Holloman AFB, N.M., at Inertial Guidance Symposium, Holloman AFB, Oct. 19-21.

Lt. Gen. T. P. Gerrity, Dep. Chief of Staff, Systems and Logistics, at Air University, Maxwell AFB, Ala., Oct. 25.

Navy-Industry Conference on Systems Effectiveness Set

"The Impact of Systems Effectiveness Contracting," will be the theme of the Ninth Navy-Industry Conference on Systems Effectiveness to be held Oct. 25–26, in Washington, D.C.

The program for the conference, developed by the Naval Air Systems Effectiveness Advisory Board, will include such topics as, "The Impact of Reliability Demonstrations," "The Shape of Data Today and Tomorrow," "The Impact of Logistics and Support," and "Effective Reliability Management for Total Cost."

Speakers at this year's conference will include the Honorable Robert Frosch, Assistant Secretary of the Navy (Research and Development); Mr. George E. Fouch, Deputy Assistant Secretary of Defense (Installations and Logistics); Vice Admiral I. J. Galantin, Chief of Naval Material; and Rear Admiral J. P. Sager, Assistant Commander, Material Acquisition, Naval Air Systems Command.

NOTICE

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The Importance of... Responsibility Determinations

The following article by Captain Joseph L. Howard, SC, USN, Assistant Chief of Naval Material (Procurement), is reprinted from the Naval Material Command Procurement Newsletter. *While it was written for procurement personnel of the Navy, it is believed to be of interest to industry as well. The article reflects Defense Department policies and procedures regarding the determination of responsible contractors and is reprinted here for the information of prospective contractors.*

". . . nothing is more basic to satisfactory procurement than that we deal only with responsible prospective contractors."

Thus did Secretary of Defense McNamara point up the critical importance of source selection. Indeed, the selection of dependable sources of supply is the acid test of purchasing. No matter how well planned and designed a contract may be, if it is not awarded to a responsible supplier, it will not produce the materials or services required on time, and it will eventually increase costs to the Government. Default, late deliveries and other failures in contract performance invariably result in additional procurement and administrative costs. It is, therefore, imperative that contracts only be awarded to responsible prospective contractors.

False Economy. The award of a contract to a supplier based on price alone can be false economy if there is subsequent unsatisfactory performance under the contract. Contract awards to marginal suppliers based solely on the submission of the lowest bid or offer do not serve the objective of making Government purchases at the lowest price. Such awards act to increase the ultimate cost to Uncle Sam.

Minimum Standards. The minimum standards set forth in the Armed Services Procurement Regulation (ASPR) require that a responsible prospective contractor must:

- Have adequate financial resources, or the ability to obtain such resources as required during performance of the contract.
- Be able to comply with the required or proposed delivery or performance schedule, taking into consideration all existing business commitments, commercial as well as governmental.
- Have a satisfactory record of performance.
- Have a satisfactory record of integrity.
- Be otherwise qualified and eligible to receive an award under applicable laws and regulations.

Further, in procurements involving production, maintenance, construction, or research and development work, a prospective contractor must:

- Have the necessary organization, experience, operational controls and technical skills, or the ability to obtain them.
- Have the necessary production, construction and technical equipment and facilities, or the ability to obtain them.

While special standards of responsibility may be specified for certain procurements, a responsible prospective contractor is generally one who meets the standards set forth above.

An Affirmative Determination. The ASPR requires an affirmative determination in writing by the contracting officer that the prospective contractor is responsible before any contract award may be made. In expanding on this important point, the Secretary of Defense stated that ". . . there must be a positive judgment that he will perform the contract on schedule in accordance with its terms. This excludes the company whose qualifications are no better than borderline as to production capacity, financial capability, past performance, or any of the other minimum standards. It excludes the company whose continuing capability throughout the period of performance is jeopardized by a pending bankruptcy, reorganization, or other evidence of financial difficulty which may culminate in loss of needed financial capabilities during the period of contract performance. It means that, in predicting whether a company will perform the contract satisfactorily, it must be assumed that the Government will use vigilant and forceful contract administration. It is not acceptable to make a determination of responsibility which envisions completed contract performance only after extreme Government financial assistance and marked lenience in enforcing delivery schedules or other contract terms."

Some Exceptions. The ASPR provides that written determinations of responsibility need not be made in the case of:

- Purchases estimated to be $10,000 or less.
- Orders under existing Government contracts (except orders of more than $10,000 under basic ordering agreements).
- Contracts for perishable subsistence available for immediate shipment.

By now you are probably wondering when the contracting officer makes these determinations of responsibility and where he looks for information.

When Information Is Obtained. The ASPR provides that information necessary to make determinations of responsibility shall be obtained only concerning prospective contractors within range for an award and shall be obtained promptly after bid opening or receipt of proposals. However, in negotiated procurements, especially those involving research and development, such information may be obtained before the issuance of requests for proposals. At the same time, information concerning financial resources and performance capability should be acquired on as current a basis as is feasible with relation to the date of contract award. But, where does the contracting officer look for this information?

Where to Look. Information concerning contractor responsibility is available from a wide range of sources, including the following:

- The Joint Consolidated List of Debarred, Ineligible, and Suspended Contractors (see ASPR 1–601).
- Navy Contractor Experience List. This list is used by contracting officers as an aid in determining the current responsibility of suppliers and potential suppliers.
- The prospective contractor. Here it is significant to note that, according to the ASPR, "A prospective contractor must demonstrate affirmatively his responsibility . . ." The "burden of proof" for establishing the responsibility of a prospective contractor lies with the prospective contractor, not the contracting officer. Useful information is contained in bids and proposals, replies to questionnaires,

financial data, current and past production records, personnel records, etc.

• DOD records and personnel. Records on file and the knowledge of personnel within the purchasing office making the procurement, other purchasing offices, contract administration offices, etc.

• Publications, including credit ratings, trade and financial journals, business directories and registers.

However, it may be that these sources fall short of providing the contracting officer with enough information for a sound determination of responsibility.

Pre-Award Surveys. If the information available to the purchasing office is not sufficient to enable the contracting officer to make a determination of responsibility, a pre-award survey will call to the attention of the contract administration office any factors which should receive special emphasis. The ASPR also requires that, in procurements which are significant either in dollar value or in the critical nature of the requirement, consideration shall be given to requesting the contract administration office to verify information regarding current workload and financial capacity even though information available to the purchasing office concerning responsibility appears to be sufficient.

A Note on Small Business Concerns. If a contracting officer receives a responsive bid from a small business concern for a proposed award exceeding $10,000 and he has doubts as to the company's capacity or credit, he must have a pre-award survey made before determining that the company is not responsible for those reasons. If after receiving the results of the pre-award survey the procuring contracting officer determines that the small business concern is not responsible solely by reason of a lack of capacity or credit, he must refer the matter to the Small Business Administration (SBA).

If a certificate of competency is issued by SBA, it shall be accepted by the contracting officer as conclusive of a prospective contractor's capacity and credit. If the contracting officer still has substantial doubt as to the concern's ability to perform, the case must be forwarded through channels on an expedited basis to the Director of Procurement, Office of the Assistant Secretary of the Navy (Installations & Logistics), for review. Procurement action must be withheld pending receipt of instructions from that office.

Here are a few additional points on referrals to SBA:

• The contracting officer may, at his discretion, refer cases to the SBA where a bid or proposal of a small business concern for a proposed award exceeding $2,500 but not exceeding $10,000 is to be rejected solely because he has determined the concern to be nonresponsible as to capacity or credit.

• A referral need not be made to the SBA if the contracting officer certifies in writing that the award must be made without delay.

• A referral need not be made to the SBA if the contracting officer determines a small business concern nonresponsible for a reason other than lack of capacity or credit.

Determinations Will Be Supported. Contracting officers can expect to get high-level support of their responsibility determination decisions. Here are a few examples of the type of support they can expect:

From the Comptroller General of the United States:

> **"The projection of a bidder's ability to perform if awarded a contract is of necessity a matter of judgment. While such judgment should be based on fact and should be arrived at in good faith, it must properly be left largely to the sound administrative discretion of the contracting officers involved, since they are in the best position to assess responsibility, they must bear the major brunt of any difficulties experienced by reason of the contractor's lack of ability, and they must maintain the day-to-day relations with the contractor on behalf of the Government."**

From Graeme S. Bannerman, Assistant Secretary of the Navy (Installations and Logistics):

> **"It is our policy that contracts are to be awarded at the lowest sound price. This means that we intend to make awards only to the contractors who have established their technical and financial qualifications to make timely delivery of reliable equipment . . . We do not intend to do business with unqualified or marginal producers. There is no benefit to the Government in making an award to the lowest bidder unless he can deliver reliable equipment."**

From Vice Admiral I. J. Galantin, USN, Commander, Naval Material Command:

> **"We in the Naval Material Support Establishment must provide reliable, timely support to the fleet. Since much of our support is provided through contract, we must have reliable contractors. Contracting officers can be assured of my support in this endeavor."**

Decision making in any situation is the toughest management demand. To make a decision in the environment of contracting is doubly tough—and doubly important. A good decision is not an arbitrary decision, but one based on facts, and this is also the key in making good responsibility determinations. Get the facts. Make an honest decision. And you will be supported.

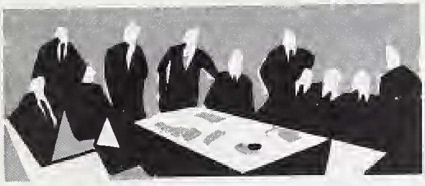
The importance of candid and correct responsibility determinations by contracting officers cannot be overemphasized—for the objective of a procurement action is not to produce a contract, but to produce the material required by our operating forces in a timely manner and at a reasonable cost to the United States taxpayers. This objective can be accomplished only if contracting officers assure that contracts are always placed in the hands of responsible contractors.

Gurnee to Head Contractor Cost Reduction Program

The responsibility for systems development and program review, formerly split between two staff offices, has been centered in the Office of the Deputy Assistant Secretary of Defense (Logistics Services), Office of Assistant Secretary of Defense (Installations and Logistics).

The Directorate for Cost Reduction Policy, which coordinates and administers the Defense Contractor Cost Reduction Program, will perform the functions for systems development and program review.

Commander Herbert L. Gurnee, SC, USNR, former head of the Navy's Cost Reduction Office, will head the Defense Contractor Cost Reduction Program.



MEETINGS AND SYMPOSIA

SEPTEMBER

Symposium on **Galio-Arsenide**, Sept. 26-27, in Reading, England. Sponsor: AF Avionics Laboratory, Research and Technology Div., Air Force Systems Command, Contact: R. W. Runnells (AVN), Air Force Avionics Laboratory, Research and Technology Div., (AFSC), Wright-Patterson AFB, Ohio 45433. (Area Code 513) 253-7111, ext. 5-3802 or 5-5362.

Sixth Annual National Conference on **Environmental Effects on Aircraft and Propulsion Systems**, Sept. 26-28, at Princeton, N.J. Sponsor: Naval Air Turbine Test Station. Contact: Dennis Wysocki, Conference Vice Chairman, Naval Air Turbine Test Station, P.O. Box 1716, 1440 Parkway Ave., Trenton, N.J. 08607. (Area Code 609) 882-1414, ext. 355.

Sixth Symposium on **Naval Hydrodynamics, Maneuverability, Waves and Physics of Fluids**, Sept. 29-30, Oct. 3-4, at Washington, D.C. Sponsor: Office of Naval Research. Contact: Mrs. S. W. Doroff, Office of Naval Research (Code 438), Washington, D.C. 20360. (Area Code 202) OXford 6–1433 or 6-6839.

OCTOBER

Tenth Annual **Organic Chemistry** Conference, Oct. 4-5, at Natick, Mass. Co-sponsors: Army Natick Laboratories and the NAS-NRC Advisory Board on Military Personnel and Supplies. Contact: Louis Long Jr., Head, Organic Chemistry Laboratory, Army Natick Laboratories, Natick, Mass. (Area Code 617) 653-1000, ext. 414.

Sixteenth Annual Symposium on U.S. Air Force **Antenna Research and Development**, Oct. 11-13, at the University of Illinois, Allerton Park, Ill. Sponsor: Air Force Avionics Laboratory. Contact: Mr. Turner (AVWE-3), Air Force Avionics Laboratory, Research and Technology Div., (AFSC), Wright-Patterson AFB, Ohio 45433. (Area Code 513) 253-7111, ext. 5-5720.

Classified Advanced Planning Briefing for Industry on **Electronic Systems**, Oct. 18-20, at Boston, Mass. Co-Sponsors: Air Force Electronic Systems Div., (AFSC) and National Security Industrial Assn. Contact: Paul A. Newman, NSIA Dept. N., Suite 800, 1030 15th St., N.W., Washington, D.C. 20005.

Colloquium on the **Photographic Interaction Between Radiation and Matter**, Oct. 26-27, at Washington, D.C. Co-sponsors: Air Force Office of Scientific Research and the Society of Photographic Scientists and Engineers. Contact: Dr. Amos G. Horney (SRC), Air Force Office of Scientific Research, Washington, D.C. 20333. (Area Code 202) OXford 6-8705.

NOVEMBER

25th Anniversary Symposium on **Personnel Research and System Advancement**, Nov. 1-3, at San Antonio, Tex. Sponsors: Personnel Research Laboratory and Southwest Research Institute. Contact: Jack Harman, Southwest Research Institute, San Antonio, Tex. (Area Code 512) OV 4-2000.

Ship Control System Symposia, Nov. 15-17, at Annapolis, Md. Sponsor: U.S. Navy Marine Engineering Laboratory. Contact: Walter J. Blumberg, Steering Committee Chairman, USN Marine Engineering Laboratory, Annapolis, Md. (Area Code 301) 268-7711, ext 8670.

Fifth Annual Symposium on **Physics of Failure in Electronics**, Nov. 16-18, at Columbus, Ohio. Co-Sponsors: Battelle Memorial Institute and the Rome Air Development Center. Contact: Joseph Schramp (EMERP); Rome Air Development Center, Griffiss, AFB, N.Y. 13442.

Third Annual **Failure Analysis** Seminar, Nov. 17-18, at the NASA Manned Spacecraft Center, Houston, Tex. Sponsor: Texas Chapter of the American Society for Metals and NASA-MSC. Contact: Dr. David E. Hartman, Houston Research Institute, Inc., 6001 Gulf Freeway, Houston, Tex. 77023. (Area Code 713) 928-5001.

Third Congress on **Information Systems Science and Technology**, Nov. 21-22, at Buck Hills Falls, Pa. Co-Sponsors: Electronic Systems Div., (AFSC) and Mitre Corp. Contact: Col. C. A. Laustrup (ESRC), Project Officer, Electronic Systems Div., (AFSC), L. G. Hanscom Field, Bedford, Mass. 01731. (Area Code 617) 271-4527.

Symposium on the **Structure of Surfaces**, date undetermined, at Durham, N.C. Sponsor: Army Research Office-Durham. Contact: Dr. H. M. Davis, Director, Metallurgy and Ceramics Div., Army Research Office -Durham, Box CM, Duke Station, Durham, N.C. 27706. (Area Code 919), 286-2285, ext. 31.

DECEMBER

15th Annual **Wire & Cable Symposium**, Dec. 2-9, at Atlantic City, N.J. Sponsor: U.S. Army Electronics Command. Contact: Milton Tenzer, Electronic Parts and Materials Div., Electronics Components Laboratory, U.S. Army Electronics Command, Fort Monmouth, N.J. 07703. (Area Code 201) 535-1834.

First **Nuclear Criticality Safety** National Topical Meeting, Dec. 13-15, at Las Vegas, Nev. Sponsors: American Nuclear Society and organizations and contractors of the Atomic Energy Commission, National Aeronautics and Space Administration and the Air Force. Contact: A. J. Smith, Nuclear Reactor Safety Group (WLAS-1), Air Force Weapons Laboratory, Kirtland AFB, N.M. 87117.

Warner Robins AMA Gets CV–2 Logistics Chores

Logistics support management of the CV-2 Caribou aircraft, which the U.S. Air Force will receive from the Army under an interservice agreement assigning responsibility for transport aircraft in combat zones to the Air Force, has been assumed by the Warner Robins Air Materiel Area, Robins AFB, Ga.

San Antonio Air Materiel Area, Kelly AFB, Tex., already inventory manager for the Pratt & Whitney R–2000 engine which powers the DeHavilland-manufactured CV–2, will provide logistics support for the engine.

Under the agreement, the Air Force will receive 144 Caribou aircraft.

Warner Robins will also manage logistics support of the DeHavilland CV–7 Buffalo, now in the research and development stage. No assignment has been made on the Buffalo's T–64 engine.

Navy Tests Automatic HELO Escape System

The U. S. Navy is testing a unique new helicopter fuselage capsule escape system which can be activated automatically by the pilot or one of the crew and does not require any action by passengers in an emergency.

The system begins operation when rotor blades are jettisoned to provide a clear area for parachutes to open. Next, the fuselage is severed to separate occupied and unoccupied sections. Separation rockets are ignited on the unoccupied portion thrusting it away to prevent collision between the sections. Parachutes bring the occupied fuselage section safely to earth.

H-25 helicopters, specially designed for remote controlled flight, are being used as test vehicles. The test program is being conducted by the Naval Aerospace Recovery Facility, El Centro, Calif.

FROM THE SPEAKERS ROSTRUM

Address by Dr. Chalmers W. Sherwin, Dep. Dir. (Research and Technology), Office of Dir. of Defense Research & Engineering, at meeting jointly sponsored by the Patent Law Assn. of Chicago and the Chicago Assn. of Commerce & Industry, Chicago, Ill., April 27, 1966.

Dr. Chalmers W. Sherwin

Project Hindsight Measuring the Payoff of Research and Technology to Defense

Early in 1964 we started to attack the problem of trying to assess the importance and value of research and technology to defense and to see if there is a favored way of managing it to produce high pay-off. After considerable discussion, we decided to focus on an examination of past accomplishments rather than the prediction of future ones. The reason for this decision was basically pragmatic. We believed that it took five to 10 years for discoveries or inventions to be applied to the Defense inventory and, thus, have their utility established unambiguously. We had to be certain that the accomplishments we focused on had an identifiable utilization. Scientists and engineers have a proclivity to wave their arms and point enthusiastically toward the future predicting great things for their recent pet discoveries and inventions, and they strain at the leash to spend the next billion dollars of research and technology money. Few, however, have any interest in what happened with the last billion dollars, not to mention the $10 billion which we estimate DOD has spent in this category since 1946. We wanted to find out what this large sum had accomplished and also to see if we could find any general lessons regarding its efficient management which might prove applicable today. We are particularly interested in principles which can be effected through policy actions in DOD.

Our approach is as follows: Select a recent weapon system (we took the Bullpup air-to-ground tactical guided missile as a pilot study), examine all of its subsystems and components and in each case ask, "What recent scientific knowledge or new technology is important to the increasing of the performance or reducing of the cost?" "Where was the work done?" "What motivated the creators?" "How was the research initially financed?"

Our first goal was to prove to ourselves that one could identify discrete research or exploratory development events (which we call RXD events) which are, in fact, clearly important to improving the cost effectiveness of the system.

(In DOD, the program we call exploratory development is largely technology.) In Bullpup, the ad hoc team in the Office of the Director, Defense Research and Engineering, identified 43 RXD events and ran down the essential background information on most of them. For example, one event (research category) was the development in 1942 of the theory of correlation, statistical filtering and prediction by Norbert Wiener. In 1950, this theory was applied at the Massachusetts Institute of Technology to radar signal detection using an electronic correlator (a second research event). In 1952, the correlator concept was used at the Martin Company to design an anti-jam radio guidance system as an alternate system for the Matador missile. (This extension of the concept to radio guidance is an exploratory development event.) When the Martin Company received the Request for Proposal for the Bullpup, they included the anti-jam radio link as part of their plan and, when Martin received the contract, it was incorporated into Bullpup.

I recite this history of three related RXD events not only to illustrate what we mean by RXD events, but also to illustrate several of the characteristics which our later studies confirm and illuminate. In 1942, Wiener was led into his basic theory because he had been worrying about the fire control problem for anti-aircraft guns. He was supported by a continuing Office of Scientific Research and Development contract at MIT. In 1950, Lee and Wiesner at the Research Laboratory for Electronics at MIT (a laboratory supported mainly by DOD sustaining program money), along with two graduate students (Cheatham and Singleton), were seeking to improve radar detection. They extended and interpreted the theory and demonstrated its application to the signal detection area. In 1952, Alpert at the Martin Company, who was supported by a combination of Matador guidance improvement funds and independent corporate funds, turned the MIT concept into an anti-jam radio control system.

What do we notice that these events have in common? First, they form a causally related chain with a thread of common personal communication. Second, all three events had to happen for Bullpup to get its jam-free control link. Third, the innovators were in each case directly exposed to urgent, real-life problems related to defense. Fourth, they were able to almost immediately pursue their ideas because locally controlled funds were available to carry them through the point of feasibility demonstration. Fifth, the initial job, and I stress initial, was done for a relatively small amount of money (less than $10,000 in each of these cases), illustrating that modest amounts of locally controlled funds available on short notice for research and technology are important, probably essential to innovation.

Each of these conclusions has been confirmed BY our current data base which is now over 10 times larger and includes information on eight additional systems. There seems to be a clear pattern in the successful application of innovative technology.

In addition to the three Bullpup events discussed above, there were 40 others which I cannot take the time to describe further. They ranged from the development of the thermal battery to new rocket engines and fuels, to new gyros and control systems. Again, we were examining new science and technology, a class that is generally described as "post World War II." Looking at the time history of the 43 events, it is significant that 23 of them occurred over a 12-year period, prior to the original 1954 development contract to the Martin Company, and 20 occurred afterward. The last one occurred in 1964, no less than 4 years after the second production contract! This shows how, if the management system permits it, there is a continual flow of innovating technology into a weapon system at all stages, continually upgrading its performance or reducing its cost. This situation, in which much further innovation is needed after system definition, was not due to poor planning. A 1953 Bureau of Aeronautics report (the Pitkin report) made a careful analysis of the system concept and concluded that the technology was in hand to do the job.

Let us look at some other features regarding the Bullpup events. An examination of funding sources shows that 74 percent of the events were funded by DOD dollars, 24 percent by corporate investment (mostly by defense industry) and two percent by foreign defense-oriented sources.

Eighty-seven percent of the events had as "targets" a Government system or technical problem, predominantly military, and no less than 38 percent were specifically directed toward the Bullpup system itself.

Nine percent of the events were in the research category (which is high, we have discovered since).

Universities were the originating source of six percent of the events, Government in-house laboratories 26 percent and industry 63 percent.

What has all this accomplished? We now have an operational missile which is several times as effective against defended point targets such as bridges, ships, etc., as compared to unguided bombs. What this means to military operations in terms of reduced sortie rates, pilot risks and support manpower is easy to appreciate.

It is not the great breakthrough, but rather the cumulative, synergistic effect of some 40-odd innovations which make the radical improvement. Each of the innovations, taken by itself, would produce little or no improvement. This finding is of fundamental importance. It implies that it takes a decade or more for enough of the inventions to "collect" to the point where one can show the feasibility of a radically improved design. It then takes a substantial number (typically 20 to 30 percent) of specific additional innovations to make practical the radically improved design. (For Bullpup, this was 46 percent.)

Finally, and perhaps my bias is showing through, we can see almost no source other than technology for significant improvement in the effectiveness/cost ratio (in the specified tactical role) of the Bullpup over the unguided bombs which it supersedes.

I have used our early study of the Bullpup as an example to illustrate both the method of analysis and the inferences one can draw from this type of analysis. Concurrently with the Bullpup study, we expanded our program through the use of a contractor (Arthur D. Little). Using in-house teams, we have expanded it again, and it now has a name—Project Hindsight, with Colonel Raymond S. Isenson as Director. We have over 400 fully-documented RXD events in our files covering the following weapons systems besides Bullpup:

- Mk 46 Mod O Homing Torpedo.
- 105mm Howitzer.
- Hound Dog Missile.
- Polaris Missile.
- Sergeant Missile.
- Lance Missile.
- C-141 Aircraft.
- SPS-48 Radar.

We have found that it takes 30 to 60 man-months to analyze a typical system at the current level of detail —about 100 events.

In addition, we have active teams working on the following:

- Nuclear Warheads.
- Navigation Satellite.
- Minuteman II Missile.
- FADAC Artillery Computer.
- Mk 46 Mod 1 Homing Torpedo.
- Mk 56 and 57 Mines.
- 152mm Warhead.

When one examines the results of the current data bank, which as I have noted is already 10 times larger than the Bullpup case, it is remarkable how the inferences made from the Bullpup study are substantiated.

Simply counting the numbers of events, we find that 50 to 150 are needed to make the quantum jump in systems capability. Nearly 80 percent of the events are funded by DOD dollars and some 90 percent had as their motivating target a Government need, predominantly military. Research events are down to only two or three percent, but several of them are very important. A substantial number of events, about 20 to 30 percent, occur after the system contract has been let. The percentage of events for in-house Government (34 percent), universities (11 percent) and industry (55 percent) is surprisingly close to the recent DOD funding pattern for applied research which, for 1964-66, was reported to the National Science Foundation as 33 percent, 13 percent and 54 percent, respectively. (We do not have any simple way to determine earlier funding patterns, but we believe they change quite slowly with time).

Once again, we find the powerful selective stimulus of need as the motivator of almost all events. Again, we find that ready funding, either locally available or quickly available by one phone call to a Government officer (when there is an already established funding or contractual basis), occurs in a large percent of the cases. We are not sure whether good ideas attract "good" (that is, flexible) money, or if innovative organizations just "happen" to always have such money. Either way, there is simply no doubt about what is needed. Available technology money simply must be spread all over the place in little pockets near the need. It is not the ivory towers which need flexible money the most, it is rather the organizations heavily involved in real problems—particularly in the early stages of development of new systems. Fortunately, there is no reason today why this decentralized decision making should not be compatible with centralized coordination. With the new digital management information system for on-going work (the Research and Technology Resumé) now in operation in DOD and NASA and soon (hopefully) throughout the Government, it will be easy to decentralize

authority to initiate research and technology and still have at all levels an up-to-date knowledge of the national program and the means to assure coordination.

Some events are unusually important in their consequences. One single research event—the transistor—followed by the cornucipia of new solid state electronic devices which flowed from it, so to speak, has had a significant impact at least a hundred times more frequently than any other event. Research in signal processing and information theory has also had an enormous impact. New engines—invariably under development for years before they are found in an important application—set the pace for aircraft and missiles development more than any other technical area, except solid state electronics. To be properly interpreted, the Hindsight events will have to be weighed by some means—at least by frequency of use.

Finally, we ask, "What has been the pay-off of the total DOD investment in research and technology?" We can estimate this by noting that in some cases the increase in effectiveness/cost can be determined with considerable accuracy (for such calculations). For example: One of the systems studied was the SPS-48, a modern, 3-D surveillance and acquisition radar. We have demonstrated that much of the critical scientific and technological knowledge required to achieve this radar was not present in 1950 or even in 1960. The radar could not have been built much earlier than it was. Now, we must assume that the planned inventory purchase of the SPS-48's is just adequate to meet the current fleet surveillance radar requirements. With this assumption one can then determine how many of the best World War II technology radars would be required to replace a single SPS-48 in today's fleet defense environment. Our calculation, based upon a "gedanken design" of an improved SP radar and normalizing on target detection capability, reveals that 40 of the best possible World War II radars distributed geographically over the coverage area could barely match the performance of one SPS-48. This also means that 39 additional ships and 1,000 sailors to man these ships also would be required for each SPS-48 replacement. Multiply these figures by the number of SPS-48's required for the fleet and a real measure of the return on investment in research is apparent. We calculate that it would cost at least $15 billion more to achieve current capability without new science and technology and operate it for just one year . . . .

Summarizing: First, we believe we will be able to demonstrate that, properly managed, the value of the returns from the Government investment in research and technology outweighs by orders of magnitude the investment itself. Second, the key to proper management appears to be: Make the necessary financial and other resources easily and quickly available to the scientists and engineers who are closely coupled to the real technical problems of society.

Address by Mr. Frank Thomas, Asst. Dir., Nuclear Weapons, Office of the Director, Defense Research and Engineering, at the National Seminar of the National Classification Management Society, Los Angeles, Calif., July 13, 1966.

Classification and Technical Breakthroughs

I have selected my topic because I consider that the classification of new technology can have a strong effect, a feed-back on the general advancement of technology—and this relationship is not always recognized. As I have reviewed my talk, I discovered that perhaps most of what I will say today will be to tell you some of the difficulties in arriving at a proper classification for new technology. I hope I will be able to provide some new perspective to make the job of classification a little easier and perhaps a little more effective.

Within the Office of the Secretary of Defense there is a great deal of emphasis placed in "quantifying" the information required to make any decision. The first step in any major decision process is usually to quantify or place numerical values on all parameters in which this is possible and reserve for judgment only those items which cannot be so quantified. In trying to apply that rationale to the subject under discussion, I discovered very little that can be so quantified. We can examine past experience and, with reservations, project this experience into the future. But there are few positive statements that one can make with confidence.

Technological progress depends upon the creativity of individuals. And the creative process is a delicate one. Except on a statistical basis, it is nearly impossible to predict how or under what conditions new technology will be developed, when it will be developed, or even if it will be developed at all. I will discuss some of these statistical results and projections acquired by DOD later. But we know that the creative process does depend heavily upon an individual being able to acquire, examine, question and evaluate all new and pertinent information, and classification can have a major impact on the accessibility of this information.

Before discussing the development of new technology in any detail, I would like to make a point on the purpose of classification. First, try to consider and to outline the national objectives or national goals in the broadest possible terms. This can and has been done in a number of different ways, by political groups and politicians, Presidential advisory committees, philosophers and others. But for purposes of illustration let me examine briefly the national goals as outlined in the Preamble to the Constitution. If you will permit me a certain editorial license these goals are:

Goal 1. Form a more perfect union.
Goal 2. Establish justice.
Goal 3. Insure domestic tranquility.
Goal 4. Provide for the common defense.
Goal 5. Promote the general welfare.
Goal 6. Secure liberty.

If one accepts that the national goal is (in our technical jargon) to optimize or maximize these six individual goals, then it simply cannot be done. Assume for a moment that we could quantify these goals and remove the largely unknowable factors of complex human behavior. Even then, we could not simultaneously maximize all six goals. We could not maximize any two goals. Even with our simplifying assumption, mathematically we would be able to maximize only one of the parameters or one of the goals for any given situation or set of input conditions. As an example it is impossible to simultaneously achieve, say, maximum jus-

tice (Goal 2) and maximum defense (Goal 4). We must either select only one or we must achieve a balance between them. The President has established a group to examine our selective service laws in order to achieve a better balance between these two goals. The requirements of DOD cannot be met while providing absolute fairness or justice to all draftees, or potential draftees, or citizens in general. Inequalities are inevitable. The group will try to achieve the proper balance between defense and justice which will necessarily be less than optimum for each.

The framers of the Constitution, of course, realized the necessity of arriving at a balance between possibly conflicting national goals. A great deal of the Federalist Papers written by Madison, Hamilton and Jay was devoted to this subject. As an example, from the Federalist Papers, Madison states: "A wise nation . . . whilst it does not rashly preclude itself from any resource which may become essential to its safety, will exert all its prudence in diminishing both the necessity and the danger of resorting to one which may be inauspicious to its liberties." Thus Madison, in this case, tries to give some guidelines for establishing a balance between defense (Goal 4) and liberty (Goal 6).

A few years earlier, the economist, Adam Smith, observed that, "defense is of much more importance than opulence," thus stating in rather strong terms that defense is all important.

The point I would wish to make from this rather long digression is this: In the broadest sense any policy instituted by the Government, including the classification policy, cannot consider only a single national goal. Unless we are willing to forego all goals except one, the policy must consider the other goals and make at least some attempt to resolve conflict between competing goals.

The rest of my discussion will deal primarily with the cause and effect of technological development, methods to enhance defense, and comments on achieving a balance between defense (Goal 4) and general welfare (Goal 5).

Under present world conditions, DOD must see to it that the United States is in the forefront of science and technology, to protect the security of the United States against technological surprise, and to avoid obsolescence. Our defense must not be outflanked by a new scientific advance which is not part of our own arsenal.

In assuring that we are in the forefront, it is necessary to consider the interdependence of current technology —the fact that any modern technology, particularly one associated with complex weapon, space or nuclear systems, benefits from, and indeed requires, technological input from diverse sources and fields.

Early in 1964 a task group within the Office of the Director, Defense Research and Engineering, started to attack the problem of trying to assess the importance and the value of research and technology to defense and to see if there was a favored way to produce high pay-off, a favored way to achieve the proper environment. In order to avoid the natural bias of an inventor toward his most recent invention, the group decided to focus on an examination of past accomplishments rather than the prediction of future ones. It takes five to 10 years for discoveries or inventions to be applied to the defense inventory and, thus, have an unbiased assessment of their utility. The group wanted to be certain that the accomplishments that they had focused on had a clearly identifiable use. The objective of the study, called Project Hindsight, was to discover circumstances which DOD could manipulate or control, and which favor the initiation, execution and utilization of research and development program, i.e., find what techniques or methods have been successful in the past, on the average, and which had been unsuccessful, and to make at least statistical predictions concerning future development. For each weapon system the group asked:

- What recent scientific knowledge or new technology is important to the increasing of the performance or reducing of the cost?
- Where was the work done?
- A question I will examine in more detail—What motivated the creators?
- How was the research initially financed?

In nearly all cases, technological advancement occurred only when these three elements were present:

- An explicitly understood need, goal, or mission.
- A source of ideas, typically a pool of information, and experience and insight in the minds of the people who could apply it.
- Resources, usually facilities, materials, money, or trained men.

The results of the study to date demonstrate the interdependence of the technologies required for modern weapon systems. Technological breakthroughs, single quantum jumps, as one might suspect, are rare. They are the kind for which Nobel Prizes are won. Such breakthroughs might include the discovery of nuclear fission, the transistor and the maser. To go from the very basic breakthroughs, however, to a piece of hardware of significance to national defense and security is a long process involving hundreds of less spectacular and smaller steps in technology. The study showed that perhaps 50 to 150 of these smaller steps are needed to make the quantum jump in system capability. A number of these steps are made by organizations and research personnel directly working on a particular project. Some of these are in the nature of "scheduled inventions," advances originated and motivated by the desire to find a better way to solve a pressing problem for the project. But a significant number of these steps had their origin with persons remote in space, and perhaps in time, from the groups working on the specific system.

A considerable number of these steps originated in research institutions or universities which provided a new idea, a new concept, or a new analytical method which was readily adaptable to the problem at hand. Throughout the development process, free communication between technical communities and between the individual scientists and engineers is important. A solution cannot be utilized unless the person who has the problem is made aware of the solution or at least the existence of the solution. A case in point occurred in Germany during World War II. The German submarines were being badly defeated because they were unable to counter the British radar. The German Air Force captured some British radar equipment but, because of overzealous protection of the information, the German submarine command did not learn of this for six months. Undoubtedly, the war was significantly affected by this one instance of short-sightedness and over-restriction.

Another point brought out in

Project Hindsight which may bear on the topic under discussion is that of organizational flexibility. Informal personal communications are an important factor in developing new technology. Very often, the first step in approaching a new problem is to get on the telephone with a colleague who is or was working on a related problem. The colleague may be in the next building or across the country. But anything that interferes with this informal process impedes development. Nearly all technological advancement has occurred in flexible organizations in which strict lines of authority do not operate and in which there is relatively uninhibited communication between the technical personnel at all levels. Apparently, in such an organization a new idea can be more easily received and evaluated on its merits, and the inventor is highly motivated to bring forth new and unique ideas which aid in the solution of the problem being addressed by his group. By and large, new technology does not come from strict and authoritarian organizations. New technology cannot be tightly restricted or compartmentalized.

The point to be made is that any classification or other restriction on the free flow of technical information will necessarily impede the development process. This is true both within a group and between groups. The solution to a technical problem may come from a number of sources. In one case examined in Project Hindsight, a mathematical paper written many years earlier suggested a new solution. In other cases it may be from another individual or group working on a related problem or from a group working in a technology quite remote. We cannot predict solutions to technical problems. We cannot predict the origin of the solutions. And often we cannot even ask the proper questions or formulate the problem. But we can predict that the highest probability of achieving a technological advance will come under conditions in which people are highly motivated and have free access to all available information and have free and uninhibited communication within their group and with other groups.

I am not suggesting that the classification barriers which we have found necessary in this country should be lowered. Perhaps the barriers should be raised. But it should be clearly recognized by all concerned that barriers of any kind will necessarily impede and slow down the development process. Solutions will be missed, inventions re-invented, and less satisfactory means accepted. This is true in the development of hardware for defense. And it is true in the development of hardware which benefits the economy as a whole. So with regard to classification, I suggest that two judgments are required. First, how much will the classification or restriction of a particular piece of new technology restrict the development of other defense systems? The balance is one of impeding your own development as well as that of your potential or actual enemies or competitors. Second, how much will the classification or restriction of a particular piece of new technology restrict the development of the general economy? The balance here bears directly on my earlier remarks about national goals. There will necessarily be a conflict between what's best for defense and what's best for the general welfare or the general economy. Classification of particular technology may be best for our defense posture (relative to other nations) but may be bad for the general economy.

I believe that within this country we have an automatic safety valve. This lies in the high mobility of the technical community. Even when specific design information is highly restricted, the techniques and methods used to develop that design become diffused throughout the technical community in a relatively short time by a reasonably efficient method. The technical people move, change jobs and adapt the new method to solve their new problem. If a new large group is established in this country to solve some problem or design some sophisticated device, you will generally find that the group will contain individuals who have had experience at most of the major laboratories and industrial installations in the country. To some degree, the collective past experience of all these installations can be focused on the new problem. When a technical man quits his job and moves on, we consider it a loss. But to some extent he is a missionary carrying with him the techniques and knowledge he has acquired. This diffusion process is noticeably lacking in totalitarian societies, and I believe their technology is weaker because of it.

We have one other automatic feedback mechanism. A great deal of the research and technology in this country is done by commercial organizations whose primary goal is to achieve a profit for the investors. In general, if a particular new technology will perform a useful function that could not be performed before (or will do it more cheaply or more effectively than it could be done before) then it will aid the nation as a whole. In either case, there is generally an economic incentive to utilize the technology in the general economy, a profit to be made in this utilization. Management of a commercial organization will usually realize this potential and will take some action to see that the new technology, or at least portions of the new technology, are made available for this purpose. I expect that this mechanism is a far more efficient one than negotiating values between Government bureaus as required in many nations.

I have discussed the rate of technical development as being a significant factor in today's national defense. Today a nation cannot depend primarily on a depth of defense in space but is clearly compelled to develop its depth of defense in time as well. Technology is indeed moving at a rapid rate and this is a relatively new factor in defense. If you will permit me to go back 600 years, I can give you an example that this was not always so. The English in the course of their Welsh and Scottish wars developed a new instrument of warfare, the long bow. It clearly outranged and outmatched the crossbow which was in general use on the continent at that time. In the course of these wars the English had also developed the tactics which made good use of their new technology. In 1346 King Edward with an English army of 20,000 met a French army of 40,000 at Crecy in France. The French army was vastly superior in mounted men and armor, and in continental warfare this was about all that counted. With the longbow, however, the English were able to engage the enemy at a great distance, and the French, under this rain of arrows, were unable to assemble any reasonable charge of their armored knights. The French army was practically annihilated. Sixty-nine years later the

English again met the French at Agincourt. Again the English had the longbow and the proper tactics and the French did not. Again, the French knights were virtually annihilated. In 69 years the French had neither copied nor countered the new English weapon. It required another 200 years for the final defeat of the armored knight in the person of Don Quixote, under the pen of Cervantes.

I came upon another example a few months ago while touring El Morro Castle in San Juan, Puerto Rico. King Charles of Spain authorized the construction of the castle in 1523. Some 20 years were spent in raising funds to build the castle, another 10 or 15 years in designing it, so that the first fortification was not completed until 50 years after it had been authorized. I have heard comments about the long time sometimes required today to get military construction authorization and appropriation but I think no one can argue that the pace of technology has increased at least a little since El Morro was built. . . .

. . . Note that the segments of the economy increasing most rapidly are those in which the most technical advancement is occurring — electronics, communications, chemicals. Segments declining are those in which there is almost no technological advancement, such as wooden containers.

Time scales will be further shortened. This time factor in itself introduces a new facet in defense planning. It suggests that a nation might assure its security simply by advancing more rapidly than all potential enemies. It is a facet that renders opposing forces obsolete by the time they are deployed. The opposition is outflanked in time, rather than in space. This is clearly not the case in all fields today, but it is a strong factor in many fields. This time factor is more important during an all-out war than it is at a time like the present. During an all-out war the cycle time between offense and defense is shortened. There is rather complete knowledge of the weapons being used by the opposition and a strong incentive to develop techniques to counter these new weapons.

In reviewing the classification problem under wartime conditions, I would like to quote a paragraph from the report of the Office of Scientific Research and Development (OSRD), written in 1946 by the scientists and engineers who were engaged in this race during World War II. The report states that "In the midst of war, it is clear that the best security lies in speed, in achievement, rather than in secrecy. That this secrecy can defeat its own purpose is shown by the frequency with which enemy scientists independently discovered techniques zealously guarded by us. Our secrecy merely slowed our own production and decreased our time advantage." I should point out that the fact of independent discovery also operates in peacetime. The history of technology is full of examples of near simultaneous discovery by two independent parties. This process is doubtless still continuing in certain areas. Again referring to wartime conditions, the OSRD report states that, ". . . Science in its military applications as well as in the basic form, must be a 'free science' in order to be strong. . . . Contributing parties must be adequately informed about the tactical and technical problems. In spite of this obvious fact, there was far too much indiscriminate, blind classification of military information, scientific discoveries, technical equipment, and correspondence. Not only were our civilian scientists given too little access to military planning but they were also kept in mutual ignorance of scientific advances in cognate fields. Discoveries made in radar should have received much wider dissemination to those working in communications, television, underwater sound, and other fields. That these discoveries were not so distributed is a sad reflection on the scientists themselves who were temporarily forgetful of the very essence of creative thinking—freedom of publication. No one is suggesting unrestricted publication in the public journals, but surely there could have been a series of classified journals, available to all cleared scientists, which would have broken down artificial and highly injurious barriers. The writer has personal knowledge of many instances where greater restricted distribution of basic scientific and technological data would have profoundly increased our scientific strength." Thus, at least in the mind of some World War II scientists, over-restriction of data did have an adverse result.

A sustained high rate of growth also enhances national security by promoting the productive and economic growth of the country. Thomas Paine once said: "War involves in its progress such a train of unforeseen and unsupposed circumstances that no human wisdom can calculate the end. It has but one thing certain, and that is to increase taxes." However, in the past year the United States has simultaneously made a large increase in our efforts in Southeast Asia, has cut taxes, and has just established a record for revenue in a single year. Perhaps our dramatic rate of growth has contradicted Tom Paine.

National security is indeed related to overall national strength. And continued growth in overall national strength is heavily dependent on continued rapid advances in technology, better transportation, better communication, a technology that permits increased output for every person in the labor force and from every bit of our natural resources expended. This continued technological growth requires a free interchange of technical information between scientists and engineers.

In conclusion then I would like to summarize the points I have made as follows:

• An effective classification policy must include consideration of the effect that possible restrictions of information will have on other technical developments. Such restrictions will necessarily have some adverse effect on the development of your own systems for national defense and national security.

• Such restrictions will also necessarily have an adverse effect on the growth of the economy as a whole and national security is not unrelated to this growth.

• The requirements for national defense in as absolute sense are not ends unto themselves but must be balanced against other necessarily competing requirements such as justice, liberty and general warfare.

I hope I have provided you with some added perspective. I have tried not to argue for or against any particular classification actions, but I have tried to point out that future technological growth in defense and in non-defense industries cannot be ignored in arriving at classification decisions.

Can the Aerospace Industry Meet Reliability Requirements for Manned Space Flight?

by

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My approach to the question of whether the aerospace industry can meet reliability requirements for manned space flight will be to trace very briefly the evolution of aerospace quality control from the World War II techniques of brute force and super-saturation through the various advances of today's relatively sophisticated system. I will then outline in general terms my assessments of the changes which must come about if we are to provide the assurance that aerospace equipment and military materiel will perform their intended function for the specified mission.

Prior to World War II, Government contracts had no firm requirement for contractors to employ systematic quality control. The Government automatically re-inspected all products 100 percent! The staggering volume of wartime production soon made this completely impossible. Thus, the Government was forced to a spot-checking technique which lacked both depth and thoroughness. The weaknesses of this approach certainly cost lives and dollars, and our successes were achieved only by overwhelming volume.

In the years prior to and during the Korean buildup, the need for a more sophisticated system became apparent. High performance jet aircraft were designed for the delivery of atomic weapons, and reliability requirements became more imperative. It was in this environment that the Air Force developed its first real quality control system as outlined in Specification MIL–Q–5923 and subsequent revisions. This system recognized that quality hardware could only be produced by the contractor's systematic control of quality. The specification, therefore, generally outlined requirements for a contractor's system formally incorporating tool and guage calibration, material review boards, certification of materials and special processes, nondestructive testing, vendor quality reviews, sampling plans, etc.

Within the past dozen years the aerospace industry and, in fact, the entire nation faced a higher order of complexity with even more critical demands for reliability. The urgency of the requirements called for a variety of new management techniques, including the concept of concurrency wherein development, test, production and installation could, and frequently did, overlap each other. In this environment the three Military Services agreed on Specification MIL–Q–9858 (and later 9858A) which placed substantially more responsibility on the contractor, requiring that he control subcontractors, certify operating specialists and vendors, control non-conforming supplies, maintain quality cost data, etc. Scrutiny of this system by various Government quality representatives varied from one installation to the next, soon developing the need for more consistent formal application by the Government. To meet this need the Air Force developed the Contract Management Quality Assurance Program augmented by a uniform Continuous Audit Program. These procedures provided increased flexibility for verifying the contractor's system to the depth required.

The news from Cape Kennedy and Vandenberg remind us from time to time that quality assurance has not adequately kept pace with the scientific and technological breakthroughs which place us today in the era of space flight, both manned and unmanned. Despite the inadequacies of today's system, however, the record is surprisingly good!

During 1965, out of 64 launches conducted by the Air Force's Space Systems Division, for example, 61 were successful. In 1964, the totals were equally impressive—66 successes out of the 69 National Aeronautics and Space Administration and Defense Department launches performed by the Air Force System Command's Space Systems Division.

Over the full two-year period, that's 127 for 133—or better than 95 percent success on the launch pad.

Included in these totals are some phenomenal achievements. The Thor as a space booster, for instance, had 39 successes in CY 1964, 29 in CY 1965, and entered the new year with a running total of 70 consecutive successful launches. Atlas was 19 for 19 in 1964, and 15 for 17 in 1965. And in more recent months, all ten Gemini launch vehicles have performed flawlessly.

A word, however, about our failures. All satisfactory launches do not connote complete success. Unless we achieve complete payload performance

Air Force Atlas Agena.

as planned, our mission is not complete. Despite sophisticated telemetry, there are cases where unmanned space vehicles have failed to perform as planned and we simply do not know why.

In such a case, corrective action can be a baffling challenge. Solutions may be sought through design analysis, simulated operation in the laboratory, or even replacement of the suspicious unit(s) with others where previous experience has been more successful. There is no uniform approach especially in view of tight program schedules.

A review of quality assurance techniques applied to date points out the fact that almost the entire effort is expanded in the search for non-quality, i.e., the detection of defects. Where our detection fails us, we see, at the worst, catastrophic failure of extremely costly hardware, not to mention casualties and, at the best, costly program delay. A truism that has survived, though not without challenge, is that we cannot inspect quality into hardware.

Even if we overlook the possibility of catastrophic failure, the cost of program delay which defective hardware can produce staggers the imagination. For example, it is generally recognized that a manned flight to Mars will involve an expenditure of approximately $50 billion over a 15-year period, or $10 million per day. All of this effort would culminate in the flight of less than 10 spacecraft from Earth to Mars. Thus, the national investment in each would represent a minimum of $5 billion—an unthinkable amount to be lost due to poor quality that will result in unreliability.

The manned Mars mission would be further complicated by the fact that launch windows, of approximately 45 days duration, occur only once each two years. Thus, the launch vehicles must not only be launched reliably, but they must also be launched in a timely manner. The cost, at $10 million a day, of unreliability in timeliness in meeting the launch window is as great as the investment in the vehicle itself.

Let us consider for a moment the statistics of reliability. Consider a modest space vehicle composed of eight major components, i.e., ground launch system, propulsion, guidance control, power, supplies, etc. All are extremely complex, some more than others. To oversimplify, let's say that each of these major components has six subassemblies. We must assume that each subassembly must perform properly to assure system-reliable performance. If each of these subassemblies has a reliability of 99 percent, the total system reliability will be only slightly more than 60 percent.

Fifteen years ago an analysis of these figures proved to many that such a system, like the bumblebee, could not fly. Yet it has been done. We know it can be done with even more complex systems. The successful Gemini program provides the most recent and certainly the most dramatic evidence. If we are to overcome the statistics of reliability, it is imperative that we provide an atmosphere, an environment where a relative reliability goal of 100 percent can be approached.

The pursuit of this goal during recent years has produced techniques which permit reasonably good predictions of system reliability through design analysis. These techniques enable us to pinpoint high failure components which, in turn, generate design changes such as redundancy, longer life parts, more resistant materials and self-reorganizing systems. Use of these techniques can be effective in the solution of our reliability problems. The tri-Service MIL–STD–785, "Reliability Program Requirements," stipulates the use of these techniques and is being applied to the development of major weapon systems and space vehicles.

Knowing that many of you may be driving new model automobiles, I hesitate to point to the automotive industry. However, the major motor companies are now guaranteeing material and workmanship for 24 months or 24,000 miles. As with all guarantees, you may find some small print in the contract. Nevertheless, as the cost of making good these guarantees is charged back to the manufacturing operation, we see incentives to produce reliable hardware that cannot be ignored. A quality control manager from one of the major motor companies said to me, "The dollar is a universal document! Even a vice president can understand it."

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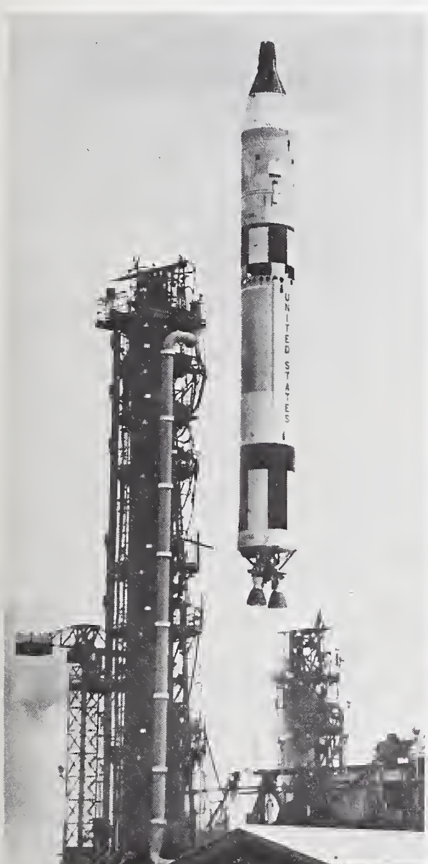
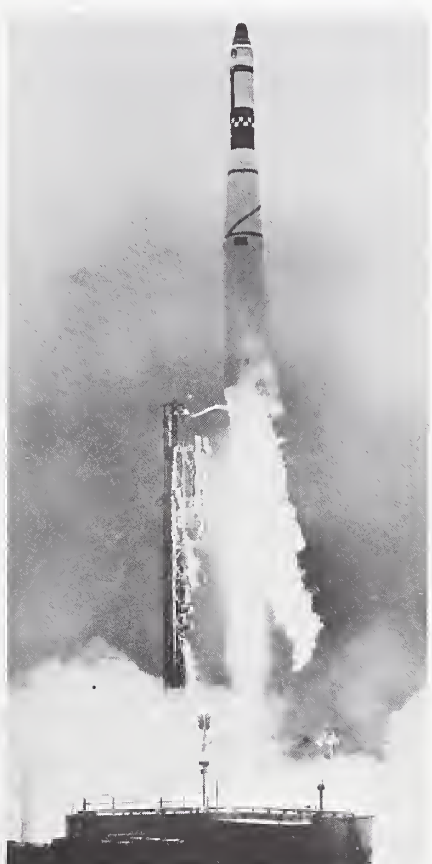


Gemini Titan II.



Air Force Thor Agena.

REWSON
A Concept Vital to Fleet Readiness

by
Capt. Dick G. Wilson, USN
Office of Chief of Naval Material

The formal establishment of REWSON began with the acknowledgement by the Chief, Bureau of Naval Weapons (BuWeps) in 1964, of a need for a central coordination authority. The need was for a coordinated effort in certain related areas which had not yet been acknowledged as being of prime importance in the naval planner's mind, as had the more obvious need for ships, submarines and aircraft. The related areas addressed are combined in the acronym REWSON, standing for Reconnaissance, Electronic Warfare, Special Operations and Naval Intelligence Processing Systems. Recognizing the vital role to be played by a REWSON concept, in 1964 an office was established in BuWeps and a Project Management Office (PM–7) in the Office of the Chief of Naval Material. This was followed closely by initiation of a REWSON office in the Office of the Chief of Naval Operations (CNO).

The functions of REWSON can be likened generally to the functions of the sensory or nerve system of the body. REWSON systems are the nerve fibers which make weapon system platforms into effective individual operating units as well as effective parts of a coordinated fleet. The REWSON concept acknowledges the need for this integrating fiber and fulfills this need by working intimately with the fleet environment from a physical and enemy-threat point of view.

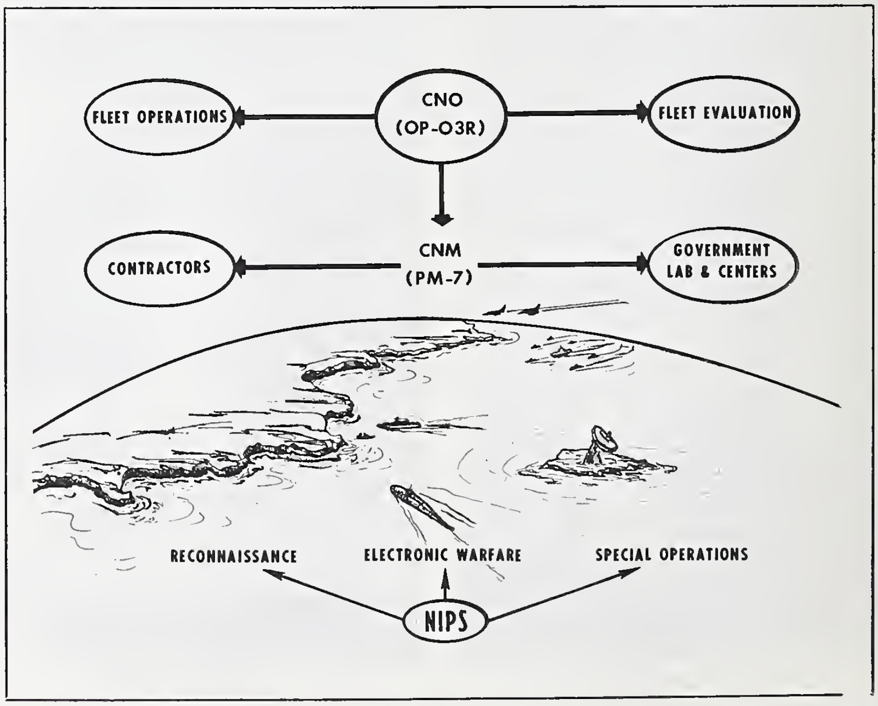
The reconnaissance sensors of ships, submarines, planes, satellites and shore stations must have adequate capabilities, and their outputs must be correlated and displayed in such a manner as to permit timely analysis and reaction. Only when navigational grid systems, resolutions, accuracies, data rates, time of intercept, etc., are known and compatible throughout will the tactical picture have meaning to the tactical commander. And only when such information is accessible in a timely manner will it be operationally valuable. Therefore, information, once gathered by tactical reconnaissance platforms, must be rapidly processed and disseminated. A system of naval intelligence processing and transmission (NIPS) is required to do this.

The fleet commander now has quickly obtained his own tactical reconnaissance data for the specific geographic area of concern; he has processed and integrated it with the data base of strategic intelligence; and he is now ready for operational planning. He is able to plan his resources to fit the geographic and enemy environment which he knows exists for day-to-day operations. He is able to put together a total picture and, equally important, the picture is current.

The element of surprise must be exploited to the maximum extent possible for each sortie in order to maximize the target kill probability. To accomplish this, the fleet commander must utilize his electronic warfare capability by identifying and locating threats and targets. He must also coordinate his electronic warfare systems to nullify, confuse and deceive the enemy defenses. This enhances survivability and, thereby, increases the cost effectiveness of a given mission.

Special operations encompass the other terms of REWSON, since special operations are often planned and executed to reconnoiter, to gather specific intelligence information, or to execute electronic warfare or other special missions. Special operations may utilize the special forces of the amphibious-type commanders, or they may utilize—in a special way—the more conventional forces of other type commanders, i.e., aircraft carriers, submarines, etc.

Obviously, the entire REWSON effort is complex since not only does the enemy use the entire electromagnetic spectrum, but so do all platforms of our forces. The effective



realization of a REWSON capability is necessarily the result of many years of intelligence gathering and analysis, of systems planning and integration, and of tactical training and doctrine development. The sum of these spells fleet readiness. This can only be accomplished after years of coordinated effort. Imagine, if you can, in this world of ever expanding technology, what the 1970's and 1980's hold for our Navy. Then imagine what it would be like if there were no organization which acknowledged the complexity of coordinating REWSON efforts.

The REWSON organization since its inception formally acknowledged that REWSON requirements must be compatible from ship to submarine to aircraft to satellite. It acknowledged that development, procurement, test and evaluation, training and doctrine development cannot live in a vacuum, and that the integrating fiber of the fleet nerves must be planned in all commands at all levels from concept to fleet capability. The operating Navy and the material Navy both need an organization capable of early recognition of REWSON requirements and of rapid development of the equipment, system, or tactic to fulfill these requirements. Had the need for this REWSON organization not been recognized and had we failed to activate such an organization, the imponderables of intelligence and security, of indecision and of no action might have seriously impaired the Navy's role in national defense. However, with the recognition of the vital role to be played by the REWSON organization, great strides have been made and plans are well under way for adapting REWSON to the new systems commands.

In addition, there has been a recognition of the need for other REWSON resources. The several Navy laboratories and centers are being tasked and organized to be responsive to the fleet requirements. Quick Reaction Capability procedures for REWSON equipments and systems are being finalized at the Secretarial and Chief of Naval Operations levels, and will provide definitive guidance, via the CNO Quick Reaction Capability Board, to the Commander, Naval Material Command, for five-day contracts in the most urgent instances. The resources of industry are being marshalled to provide both analytical and hardware assistance in meeting the demands of REWSON requirements of the fleet.

To summarize, the REWSON concept has caused the entire Navy to recognize the need for a coordinated systems approach in this area. Commands have responded to this by organizing to accommodate this need. The operating and material Navy has not only led the way at the headquarters level but has also tasked the field facilities, laboratories and contractors to be responsive to the concept and to the need for quick performance.

The requirement for a REWSON organization has always existed even though formal recognition of this need for integrated management is only two years old. Organizationally it is a newcomer, but it is healthy and strong, and has already made an invaluable contribution to the Vietnamese conflict. The future is even more promising as we provide for the REWSON requirements of the fleet by directing REWSON resources from a central office.

FY 1966 DSA Procurement up Due to S. E. Asia Buildup

Under the impact of the Southeast Asia military forces buildup, procurement for the Defense Supply Agency (DSA) during FY 1966 rose to $5.7 billion compared with a total procurement for the previous fiscal year of $3 billion.

The Defense Supply Agency purchases and distributes to the Military Services commonly used supplies including food, clothing and textiles, electronic parts, fuel and petroleum products, medical, chemical, industrial, construction and general supplies.

Civilian employment also increased during the past fiscal year, mainly the result of activation of additional Defense Contract Administration Services Regions (DCASR's) in the field between July 1 and the end of the calendar year.

Total DSA civilian employment at the end of FY 1966 was 52,425 full-time employees, as compared to 33,230 in the previous year. The number of military personnel during this period rose from 898 to 1,129. About 15,000 of the civilian and military personnel were added as a result of the DCASR activations.

With the completion of the DCAS consolidation during the fiscal year, DSA was administering a total of 225,000 contracts of the Army, Navy, Air Force, DSA, and the National Aeronautics and Space Administration through a network of 11 regions spanning the United States.

The number of supply requisitions processed rose to 19.4 million during the fiscal year, a jump from the 15.4 million figure of the previous year.

An innovation was the activation of the Red Ball Express, a speed-up logistics system which enables DSA to furnish at high speed desperately needed items of equipment being used in Vietnam. From inception of the express, on Dec. 7, 1965, to the end of the fiscal year, the system received 51,305 requisitions and supplied 49,005 for a 95.5 percent record.

In the overall handling of supplies by DSA, there was a system-wide increase amounting to 2,384,900 tons shipped in FY 1966 as compared to 1,575,300 tons in the previous fiscal year. During the same period, DSA received 2,567,200 tons in FY 1966 in comparison to a previous 1,404,000 tons.

Inventory value remained at $2 billion during the periods of comparison, while the number of items centrally managed dropped from 1.4 million in FY 1965 to 1.3 in the past fiscal year.

Procurement totals from all Defense Supply Agency centers rose during FY 1966. A comparative breakdown follows:

Activity	FY 1965 (millions)	FY 1966 (millions)
Defense Construction Supply Center	$ 171.1	$ 687.5
Defense Electronics Supply Center	134.7	223.0
Defense Fuel Supply Center	1,165.7	1,302.7
Defense General Supply Center	145.7	519.9
Defense Industrial Supply Center	117.0	323.6
Defense Personnel Support Center		
Clothing	317.2	1,175.6
Medical	121.7	225.5
Subsistence	839.4	1,222.0
SPUR (Special Purchases-Overseas Use)	18.9	41.9
Other	11.0	17.7

(*Continued from Page 3*)

systems analysis until we know at least what the initial alternatives are. Helping on that problem, I believe, is a major role for industry.

I might also note that it is in our mutual interest to approach the development of new systems in this way. We think it improves our chances of making the best choices and getting programs established on firm ground from the start. And it seems to me that you would certainly prefer to participate in programs which have the best chance of being successful and entering into substantial procurement.

A second way in which industry can contribute, to our mutual advantage, is by the application of the principles of systems analysis to the design of weapon systems and components. It is, of course, true that we are interested in accomplishing the necessary military tasks at the minimum cost, and I do not think that you, as citizens and taxpayers, would have it any other way. But I sense that there is considerable misunderstanding of our attention to cost. Too often our reluctance to recommend a so-called "best" system is interpreted as simply an effort to hold the budget down. Much of this impression, I believe, arises out of a confusion between "the best in the way of a single item of hardware" and "the best in the way of an overall force." Sometimes, the best overall force may be composed of a relatively small number of very capable units; other times, the best force may be composed of a rather larger number of units of lower individual capability. There is simply no rule-of-thumb that will always be right; you have to examine each case on its own merits.

When we compare alternative systems, we are interested in what we get for what we pay. It seems to me that you in industry should be in a unique position to determine which characteristics have an important effect on cost, to take a critical look at elements which add to the cost without a commensurate increase in effectiveness, and to suggest new approaches to a better balance between unit effectiveness and overall force effectivenes. I realize that many of you have value engineering activities, and I would not want to minimize their desirability nor their importance. Rather, I am suggesting that there are even greater possibilities in examining the relationship between cost and effectiveness in the conceptual stages of weapon development.

The third way in which I think industry can contribute to our use of systems analysis lies in the relationship between systems analysis and contracting. This is an area in which some progress has been made but the untapped potential seems to me to be very large, provided that we can work it out together.

In the past, without the benefit of systems analysis techniques, new weapon systems were selected primarily on the basis of performance characteristics. For example, a logistic aircraft would be described in terms of range, payload, speed, and so on, but without any specification

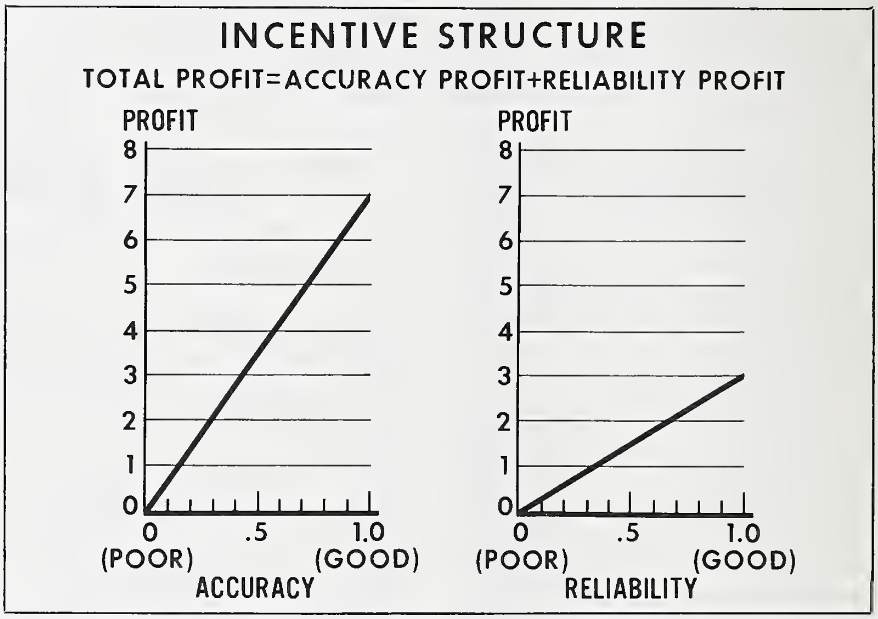


Figure 1.

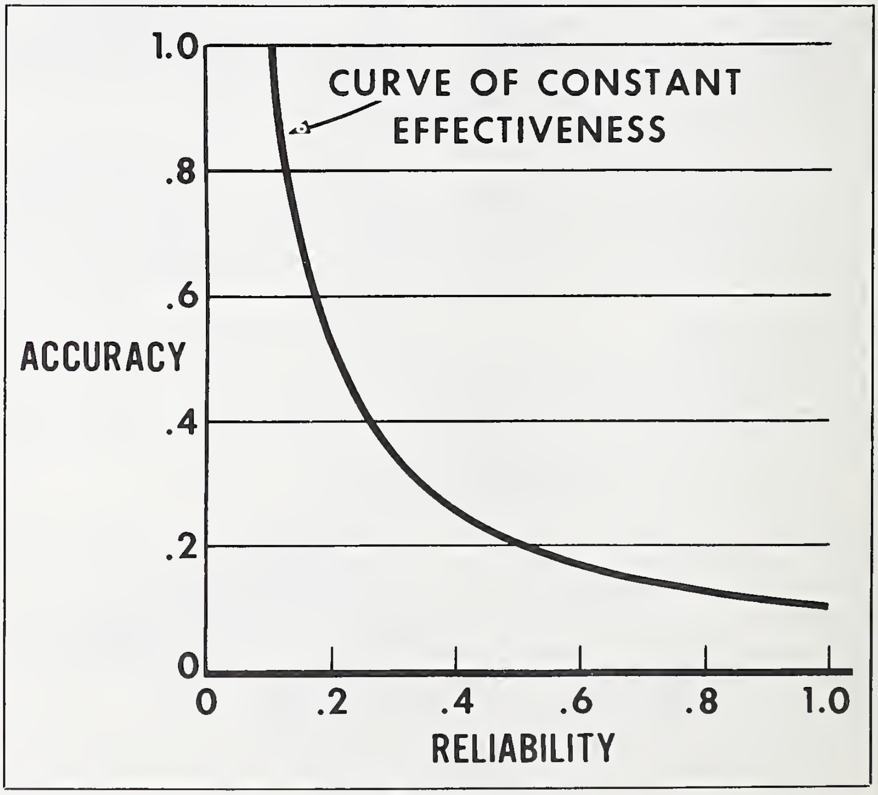


Figure 2.

as to the cost, for example, of delivering so many tons of cargo to some particular spot on the globe within a specified time. As a consequence, contracts were written in similar terms, and guarantees were based on such things as range, payload and speed.

With the introduction of systems analysis techniques as an aid in selecting weapon systems, the choice is no longer made exclusively on the basis of performance in terms of range, payload and speed. Rather, the choice is, to an increasing degree, made on the basis of the cost of accomplishing a given military task, with the classic performance parameters being merely intermediate factors in the final figures of merit. However, by and large, contracts and guarantees are still being written around the classic performance parameters.

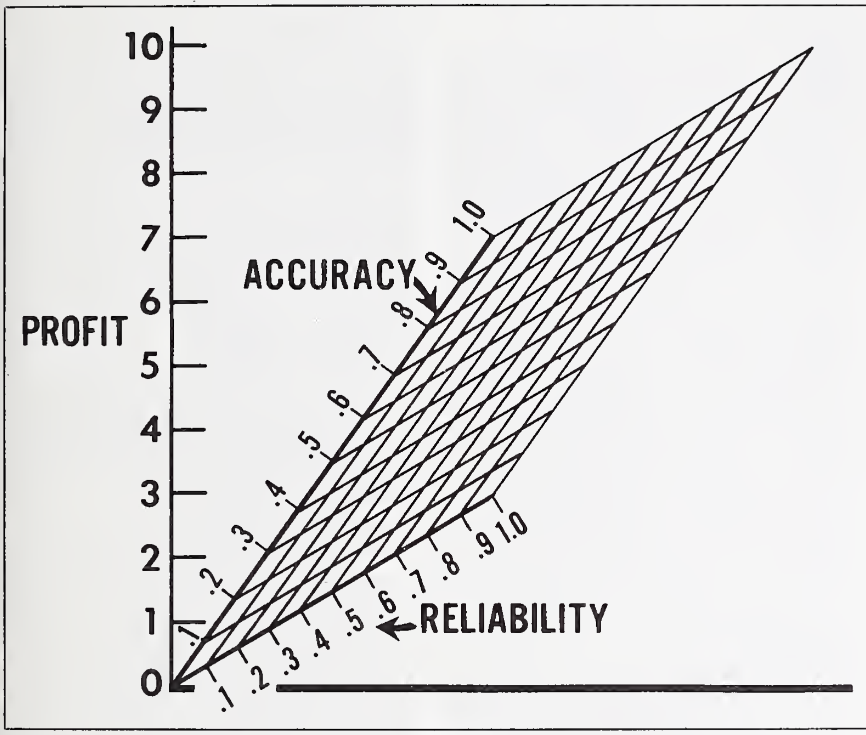


Figure 3.

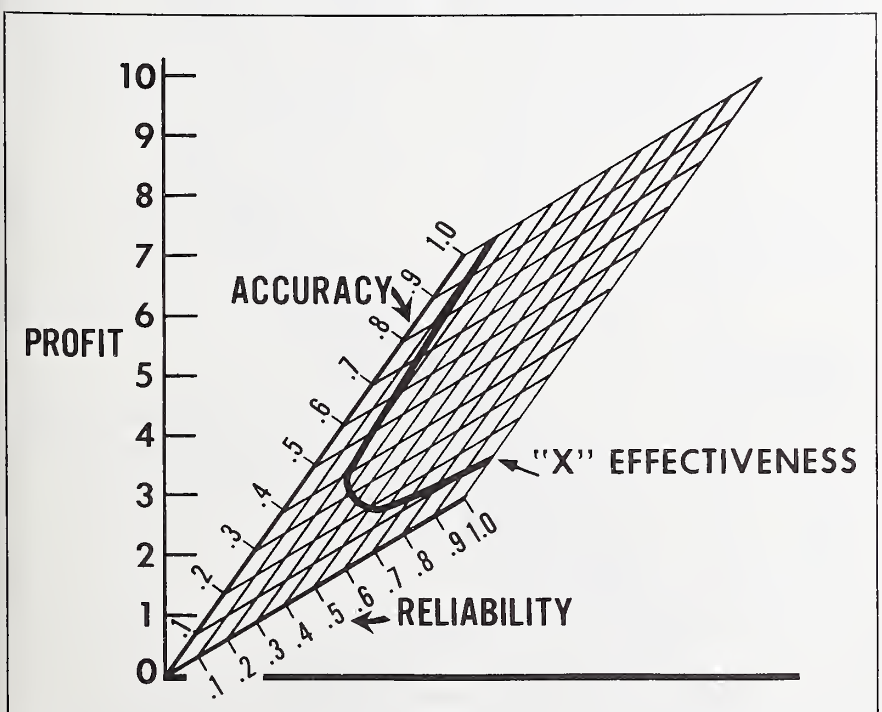


Figure 4.

On the one hand, there are advantages in doing this—one of the most obvious being that the classic performance parameters tend to be easily measured. With the increasing use of incentive contracting, the ability to unambiguously measure and compare the product against the criteria is essential.

On the other hand, electing a system on one basis, but motivating the contractor, through the language of the contract, on another leaves much to be desired. I would like to take a moment to illustrate this with a hypothetical and over-simplified example.

Let us suppose that the Government is contracting for a new missile. The Government would obviously like the missile to be reliable—so that most of the ones it buys will actually work—and it would also like the missile to be accurate—so that most of the ones that work will hit the target. Suppose, also, that to motivate the contractor along these lines, the contract establishes two financial incentives: one which increases the profit as the reliability gets better; and a second which also increases the profit as the accuracy gets better. Figure 1 shows these two incentives in graphical form.

(At this point, let me caution that I am resorting to considerable over-simplification in an attempt at clarity. I do not mean to imply that the Government would really expect a missile to have a reliability of 1.0, nor that it would be willing to accept one with a reliability of zero. All the units on this graph are hypothetical.)

The important thing about this arrangement is that the contractor's total profit is simply the arithmetic sum of whatever he derives from each of the two incentive schedules. For example, if he achieves an accuracy of 1.0, he will be assured of a profit of seven units, regardless of how well he does in terms of reliability. Anything he also achieves in the area of reliability will simply add to his seven units of profit. But does this sort of relationship make sense? Does it motivate the contractor in a reasonable

way—by which I mean—are higher profits really tied to a more effective system? To answer that, let's look at how accuracy and reliability couple to determine effectiveness (Figure 2).

Here I have shown a plot of accuracy versus reliability, and have drawn a curve of constant effectiveness—by which I mean that any combination of accuracy and reliability which falls on this curve will result in the same percentage of missiles hitting their targets. Note that if the reliability is low, the accuracy has to be high (the upper left end of the curve)—and that if the accuracy is low, the reliability has to be high (the lower right end of the curve). The point is that, in this simplified example, the Government's real concern is not just accuracy, or just reliability, but how many missiles hit the target. Whether the given level of effectiveness is obtained by getting off a lot of missiles, only a few of which hit, or by getting off a few missiles, most of which hit, should be a matter of secondary concern. At least as a first approximation, one combination of accuracy and reliability anywhere along this curve should be as satisfactory to the Government as any other point.

Keeping the general shape of the curve in mind for the moment, let us return to the incentive structure I outlined before (Figure 3). On this graph I have combined the two incentives which I showed separately in the first graph. Here, within the parallelogram, there is a slewed coordinate system. The more nearly horizontal coordinates correspond to the various degrees of accuracy from zero to 1.0, while the more nearly vertical coordinates correspond to the various degrees of reliability from zero to 1.0. Thus, all the possible combinations of accuracy and reliability fall somewhere within this parallelogram. This is really nothing more than a graphical way of adding up the two separate incentives to determine the total profit.

Having established this slewed coordinate system, with accuracy running one way, and reliability running the other, I can plot on it the curve from the last figure, which shows the various combinations of accuracy and reliability which result in the given degree of effectiveness (Figure 4).

I think that this is an interesting result. Remember that because any one point along the curve results in the same effectiveness as any other, the Government should have no particular reason to prefer any one point over any other—nor should it be willing to pay any more for one point than for any other. Yet notice how great a spread in profits there could be, in spite of the fact that there is no corresponding spread in effectiveness.

But to show how perverse this contracting arrangement really could be (Figure 5), I have added a second curve of constant effectiveness—this one showing all the combinations of accuracy and reliability which would result in a missile just twice as effective as any falling on the first curve. (For any given reliability, the accuracy is twice as good, and vice versa.) I have also shown how much profit results from two particular missile designs. To emphasize the point, I have picked the two that represent the extreme case. One missile falls at the top of the first curve, and the contractor derives a profit of a little over seven units. The second missile falls at the bottom of the second curve, and the contractor derives a profit of only about four units, even though it is twice as effective as the first missile.

This sort of incentive structure is clearly undesirable. Although the idea of inducing the contractor to increase both accuracy and reliability, in this hypothetical example, is a good thing, we must go further than that and consider the relationship between the two. This can be done through systems analysis and, if the relationship between industry and the Government is to be mutually profitable, we must match the contracting incentives, not simply to a series of intermediate parameters, but to the job to be done.

Of course, this is more easily said than done. Just how rapidly we can, or should, move in this direction, and how far we should go, is unclear at this time. I have already noted the essentiality of some relatively unambiguous way of measuring the degree to which the product meets the criteria, and some of the criteria used in systems analyses are considerably more difficult to measure than are such classic parameters as gross weight or top speed. In addition, we would have to give careful consideration to the problem of "rule beating" —by which I mean taking care to avoid the possibility of being able to meet the letter of the guarantee without meeting the spirit of the systems analysis behind it.

In any event, I would like to make it absolutely clear that my purpose is not to announce a new contracting policy, but rather to stimulate some new thoughts on an old problem: how to get the most defense from the resources available to us. What I would like to see is not a precipitous and revolutionary change in contracting procedures, but rather a sober consideration of the alternatives open to

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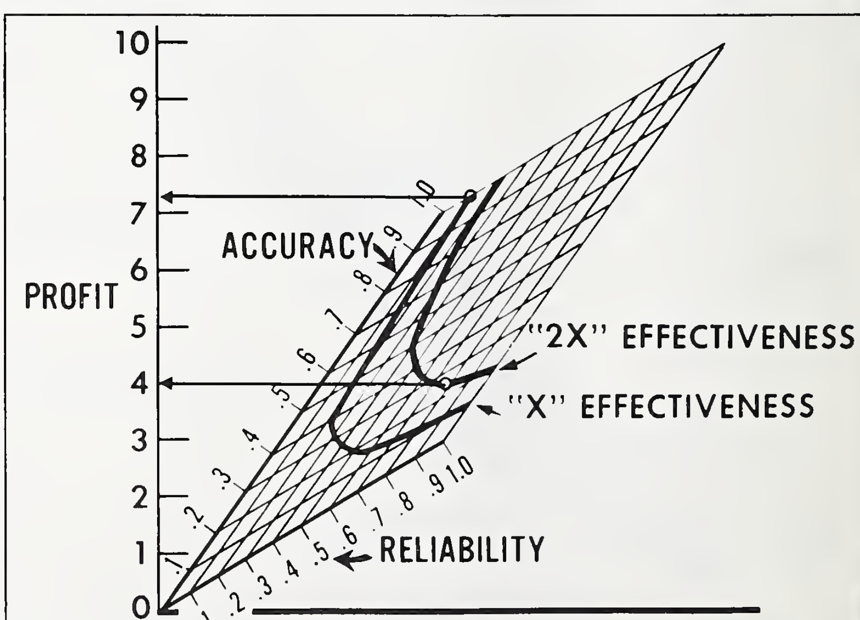

Figure 5.

R. I. P.

Reduction in Paperwork

by
Clyde Bothmer
Executive Secretary
Defense Industry Advisory Council

Some Defense contractors will breathe a sigh upon seeing the above acronym and conclude in despair that another "cult" is being introduced into their already complicated lives. READ ON! Nothing could be further from the truth.

At a Department of Defense/National Security Industrial Association Symposium in May 1965, the keynote speaker, Mr. Tom Morris, then with private industry, but before and since an Assistant Secretary of Defense, made the following statement:

> **"While this symposium is considering the technical information problem and the approaches to its solution, I recommend that it contribute new thinking, if possible, to non-technical data problems as well. I refer to the data requirements of management systems or programs, such as those concerned with Quality Assurance, Reliability, Maintainability, Value Engineering, Pert-Cost, Configuration Management, and the Integrated Logistic Concept."**

Subsequent Defense Department speakers at that same symposium pointed out that the newly-created DOD Council on Technical Data and Standardization, and the Office of Technical Data and Standardization Policy, under the Assistant Secretary of Defense (Installations and Logistics), were carefully tailored steps aimed at bringing order into the requirements levied on defense contractors for technical data.

The Defense Department has more recently focused attention on the "non-technical data problems" referred to by Mr. Morris. Assistant Secretary of Defense (Comptroller) Robert N. Anthony has created an Office of the Deputy Assistant Secretary (Management Systems Development) with important responsibilities in this area. The Comptroller's interest in management systems goes much beyond the need to assess the financial impact of Defense programs. To assure that Defense resources are used effectively and efficiently, actions are in process under Mr. George W. Bergquist, the Deputy Assistant Secretary for Management Systems Development, to attack reports proliferation problems with improvements in management systems design.

The direction of future collaboration to obtain relief for contractors from management systems implementation problems is being explored jointly by DOD representatives and a CODSIA (Council of Defense and Space Industry Associations) group. In addition, a special DOD group has completed a study which identified the management information needs of project managers. Other actions will be under way shortly.

Further, the Defense Industry Advisory Council (DIAC) (See *Defense Industry Bulletin*, April 1966) has devoted considerable attention to a report of the Aerospace Industries Association (AIA) dealing with Government management systems and data requirements incident thereto. Further work with AIA and other interested associations will be undertaken in this area by Defense. Deputy Secretary of Defense Cyrus R. Vance, in his role as Chairman of the DIAC, will continue to seek advice from the council as significant points are developed by this joint effort.

It is apparent, therefore, that paperwork problems in both the technical and management systems areas are under attack. It should also be pointed out that these are coordinated attacks, as they necessarily must be, since the line between technical and management systems data requirements is by no means a completely distinct one. But even with these complementary efforts, are all appropriate steps being taken to reduce to an absolute minimum the paperwork burden on defense contractors and subcontractors?

Assistant Secretary of Defense (Installations and Logistics) Paul R. Ignatius doesn't think so. In response to Congressional inquiries in this regard, he described some of the above points, but went on to say that "the task is a never-ending one." Accordingly, he has directed that further efforts be undertaken to assure "that we obtain no more data from contractors than is essential to carry out our responsibility for effective management of our procurement program."

In response to this direction a number of steps are being taken. For example, a subcommittee of the Armed Services Procurement Regulation Committee has been formed to examine contractual requirements and to do several case studies. Consideration is being given to asking a working group of the DIAC to help in this effort. The requirements for data levied by components of the vast contract administration field organization of the Defense Department are being examined in some detail.

A post-award examination of the first major contract handled under the Total Package Procurement Concept ("Total Package Concept" by Major General Charles H. Terhune, Jr., USAF, *Defense Industry Bulletin*, February 1966) revealed not only that excessive paperwork requirements were levied, but that the proposers submitted considerably more data than was required. Assistant Secretary of the Air Force (Installations and Logistics) Robert H. Charles told a DIAC meeting on this point: "The fact that each competitor submitted an average of 7,000 pages of cost data, in a competition for a fixed-price contract, speaks for itself." This Air Force post-award examination was so productive that other similar reviews will be made particularly aimed at uncovering areas of excessive paperwork burden.

As a further measure, the Office of the Secretary of Defense (OSD) has kept a hand on both throttle and brake in the program using Cost Information Reports to improve the DOD store of cost performance data on large systems acquisitions contracts. OSD approval is required before actual data collection requirements may be written into new contracts. The OSD Data Plan Review Committee is now an active regulatory mechanism at the Pentagon.

As other fruitful areas for investigation appear, they will be examined in line with Secretary Ignatius' directive. However, all such efforts will move forward with two principles regularly observed.

First, any such examination will be made in coordination with the major program involving technical and management systems data previously described so that duplicative efforts are avoided.

Second, none of these examinations will be handled in such a way as to generate, in themselves, additional paperwork requirements.

As Secretary Ignatius stated in regard to the control of paperwork, "the task is a never-ending one." A major part of the solution must always be found, therefore, in a never-ending search for ways to minimize and eliminate. This article was written, in part, merely to focus attention

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Government, Science and Public Policy. A compilation of papers prepared for the seventh meeting of the Panel on Science and Technology, presented to the Committee on Science and Astronautics, U.S. House of Representatives, 89th Congress, 2nd session, concerning Government, science and public policy. 1966. 58 p. Catalog No. Y 4.Sci2:G74. 40¢

Federal Handbook for Small Business. This survey provides information on all the Federal programs of interest to small business. Rev. 1966. 149 p. Catalog No. Y4.Sm1/2:F31/ 966. 65¢.

Chemical in Combat. 61R. U.S. Army in World War II, Chemical Warfare Service. This volume describes the unique position of this Service in World War II. 1966. 697 p. Catalog No. D114.7:C42/v.3. $5.25.

MILSTRIP. MILitary STandard Requisitioning and Issue Procedures, Change 12, May 1, 1966. 1966. 196 p. Catalog No. D7.6/4:M59/ch.12. $1.25.

Army Procurement Procedure, Change 2, March 25, 1966. 170 p. Catalog No. D101.6/4:965/ch.2. $1.

> Publications that require remittance are available for purchase at U. S. Government Printing Office, Washington, D. C. 20402.

Toroidal Plasma Containment with Rotating Magnetic Field. Giannini Scientific Corp., Santa Ana, Calif., for the Air Force, April 1966, 49 pp. Order No. AD-632 379. $2.

Laser Phaseography of Jets, Shocks, and Plasmas. Yeshiva University, New York City, for the Air Force, April 1966, 114 pp. Order No. AD-633 703. $4.

Tabulated Solutions of the Equation Governing Magnetohydrodynamic Flow With Aligned Velocity and Magnetic Fields. Rand Corp., for the Advanced Research Projects Agency, April 1966, 49 pp. Order No. AD-633 026. $2.

Process for Anodizing Titanium. Benet Labs, Watervliet Arsenal, N.Y. April 1966, 44 pp. Order No. AD-633 986. $2.

Influence of Some Processing Variables Upon the Elevated and Room Temperature Strength of Ultrafine Beryllium Wires. Naval Air Engineering Center, Philadelphia, Pa., May 1966, 28 pp. Order No. AD-633 992. $2.

Investigation of the Creep, Fatigue, and Transverse Properties of Al_3Ni Whisker and $CuAl_2$ Platelet Reinforced Aluminum. United Aircraft Research Labs for the Navy, May 1966, 94 pp. Order No. AD-633 241. $3.

Investigation of a Process for the Production of Metallic Filaments. United Aircraft Research Labs for the Navy, June 1966, 45 pp. Order No. AD-633 527. $2.

A Model for the Areal Pattern of Retail and Service Establishments Within an Urban Area. Northwestern University for the Navy, April 1966, 49 pp. Order No. AD-634 020. $2.

Satellite Doppler Navigation for Small Craft. Johns Hopkins University Applied Physics Labs, for the Navy, Aug. 1965, 68 pp. Order No. AD-631 024. $3.

Polyimides. Princeton University for the Navy, May 1965, 23 pp. Order No. AD-463 880. $1.

Thermal Degradation Processes in Polysiloxanes and Thermal Stabilization by a Cerium Inhibitor. Naval Research Laboratory, Washington, D.C., April 1966, 26 pp. Order No. AD-633 068. $1.

Properties of Linear Elastomeric Polyurethanes. Princeton University for the Navy, May 1966, 20 pp. Order No. AD-633 787. $1.

Research on Substituted Fluorocarbons (U). Maremont Corp., Pasadena, Calif., for the Navy, April 1965, 14 pp. Order No. AD-465 146. $1.

Broad-Band VLF Transmitting Stagger-Tuned Dipole. Naval Ordnance Laboratory, Corona, Calif., May 1966, 27 pp. Order No. AD-633 859. $2.

Electronically Steerable Array. Sylvania Electronic Systems for the Air Force, April 1966, 57 pp. Order No. AD-633 495. $3.

Portable Field Recording System. General Motors Sea Operations Dept., Santa Barbara, Calif., for the Navy, May 1966, 21 pp. Order No. AD-633 838. $1.

Procedures for the Chemical Analysis of Copper-Base Alloys. Naval Research Laboratory, Washington, D. C., March 1966, 15 pp. Order No. AD-631 067. $1.

Investigations of the Mechanisms of Decomposition, Combustion and Detonation of Solids. Aerojet-General Corp., Sacramento, Calif., for the Air Force, March 1965, 240 pp. Order No. AD-458 854. $6.

Atom Recombination on Surfaces. McGill University, Montreal, Canada, for the Air Force, Nov. 1965, 47 pp. Order No. AD-630 339. $2.

Discontinuities in the Surface Structure of Alcohol-Water Mixtures. Naval Radiological Defense Laboratory, San Francisco, Calif., Nov. 1965, 49 pp. Order No. AD-628 351. $2.

> Government research and development reports are available to science and industry at price indicated from:
>
> Clearinghouse for Federal and Scientific Information
> Department of Commerce
> Springfield, Va. 22151
>
> Authorized DOD contractors and grantees may obtain these documents without charge from:
>
> Defense Documentation Center
> Cameron Station
> Alexandria, Va. 22314

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Matching ideas with Air Force needs is also accomplished by technology reviews conducted for the Air Force by large aerospace industries. An improved understanding of Air Force needs has resulted from lectures and hardware displays during the program reviews.

The widespread dissemination of Air Force requirements assists industry in evaluating laboratory efforts which may be applied to Air Force needs. However, real progress on translating today's laboratory ideas into tomorrow's weapon systems begins with the issuance of a Defense contract assuring funds for development of the innovation.

The all-important aerospace Defense contract can be obtained by an Air Force request for proposal or by submission of a voluntary proposal to the Air Force. An Air Force request for proposal is forwarded by procurement offices to qualified sources for accomplishment of a specific task or project. Direct Air Force solicitation is limited to industries with a known capability for accomplishing the desired research and development work. The industries interested in the work respond directly to the Air Force by bidding for a contract.

Submission of a voluntary or unsolicited proposal directly to the responsible Air Force laboratory might result in a contract if the proposal significantly advances the state of the art and provides potential solutions to Air Force technical needs. Annual contract awards for unsolicited proposals average more than $30 million. Any individual or business organization interested in marketing an idea is encouraged to obtain advance guidance directly from the appropriate RTD field unit for assistance in coupling the innovation to Air Force requirements prior to submission of the proposal. The division policy protects unsolicited proposals containing proprietary data if such proposals submitted are clearly marked.

Effective marketing of new ideas for use in acquiring qualitatively superior weapon systems for the future can only be accomplished by a cohesive research and development aerospace team effort. An investment of industry ideas in Air Force technology today will assure our nation's security for tomorrow.

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Langley Air Force Base, Va. 23365

AFSC STLO (RTSSW)
Lewis Research Center (NASA)
21000 Brookpark Road
Cleveland, Ohio 44135

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on this important problem to enhance that never-ending search. But it is not enough that the Defense Department alone conducts such a search. Each major defense contractor must examine his requirements levied upon subcontractors, and each major subcontractor, in turn, upon his subcontractors. As productive results are obtained which can be emulated, or as problems are uncovered which can only be solved by DOD, information should be forwarded to the Defense Department. Only in this way, by the efforts and cooperation of all concerned, can a Reduction In Paperwork be achieved.

Foreign Military Sales and Purchases Through Calendar Year 1965

by
Hugh J. Gownley and Leonard A. Alne

Foreign military sales are authorized by Congress as a means of replacing or supplementing Grant Aid for the purpose of facilitating the kinds of arrangements for individual and collective security required to promote world peace and the foreign policy, security and general welfare of the United States. The extent of these sales became more feasible as the economic and financial capabilities of our allies improved by the early 1960's. In the same time period, the balance of payments effects of deploying U.S. forces abroad were severely felt by this nation.

In FY 1961 a vigorous program of military sales was started to replace Grant Aid to the developed countries and assist in maintaining economic capability to deploy forces abroad in a forward strategy.

During the past four and a half years a total of $10.5 billion in orders and commitments has been accumulated. The industrialized nations of Europe and the Far East account for more than nine billion dollars of this total with the minor balance of one and one-half billion dollars spread throughout more than 20 countries.

Apart from the offset of about 55 percent of the foreign exchange costs of our forces deployed abroad (exclusive of Vietnam), the sales program during FY 1962-1965 fed orders into all 50 states, creating 1,400,000 man-years of employment in 40,000 firms in more than 1,700 cities.

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Independent of the sales program, the expenditures for equipment procured abroad by U.S. forces during FY 1962–1965 and first half of FY 1966 totaled $761 million (see chart). The rate of such expenditures is declining ($143.3 million in FY 1965 and $46.9 million during July-December 1965) as a result of the special DOD 50 percent rule (favoring U.S. suppliers). Further, substantial reductions are unlikely because the "return" of optional procurement to the United States has now left almost exclusively those expenditures (e.g., public utilities, fuels, food and local economy expenditures) which must continue as long as U.S. forces and their dependents are abroad.

In connection with sales agreements, the F–111 arrangement with the United Kingdom concluded April 5, 1965, and amended Feb. 21, 1966, is the only recent sale involving agreement on the part of the United States to purchase abroad, but it is indicative of the two-way-street character that the sales program must be prepared to assume. In contemplation of an aircraft purchase (C–130, F–4 and F–111) of about two billion dollars, British authorities first proposed that DOD guarantee certain reverse procurement of defense equipment from the United Kingdom. DOD rejected this proposal on the grounds that allocated procurement invites high cost and inefficient procurement. DOD did agree, however, to search out items for which British sources appear competitive and to invite British bids for such items on the basis of equal competition (i.e., no differentials) with U.S. sources. A target of $325 million was established for such procurement over the ten-year period 1966–1975. More than 150 items have been identified as potential from United Kingdom sources under terms of cost, quality and delivery competition with U.S. industry.

We identified the major item of noncombatant small naval vessels as one that the United Kingdom might certainly provide competitively. On its first competition, however, the British yard submitted a bid 25 percent higher than the winning U.S. bid (Marinette Shipyard in Wisconsin); and the British estimate of manhours required was 2.8 times that of Marinette. However, among U.K. successes are their low bids for two ocean-going survey vessels for a total of $16.73 million and one salvage vessel for seven and one-half million dollars. In addition, the U.S. Air Force plans to use a version of the Rolls Royce Spey engine in A–7 aircraft. The engines will be built in the United States by Allison Division of General Motors, initially using engines and components supplied by Rolls Royce valued at about $100 million.

On May 13, 1966, Secretary of Defense McNamara entered into a framework agreement with West German Minister of Defense von Hassel for the purchase of Hispano-Suiza 820 20mm guns after having been advised by the Secretary of the Army that the U.S. testing program on the gun and ammunition had been completed with successful results. While we have no commitment to purchase from Germany, the Army tests showed conclusively that the best weapon available to meet a critical Army requirement in the immediate

Mr. Leonard A. Alne is Dep. for Weapon Systems Planning, to the Dep. Asst. Secretary of Defense (International Logistics Negotiations), Office of Asst. Secretary of Defense (International Security Affairs). He also supervises the activities of the United Kingdom, Near East and Far East Directorates.

time frame is the Hispano-Suiza 820 20mm gun. Therefore, in terms of available guns to meet our requirements, it appeared reasonable and in the best interest of the United States that about $75 million for this gun procurement be authorized from Germany, a country that has been spending annually some $600-$700 million for military materiel and services in the United States.

The Defense Department accepts the need for a two-way street in international defense transactions for the basic reason that we do not think that we will be able to maintain our high level of export sales unless we evidence our willingness to procure abroad at least a portion of the value of such sales. We will avoid being maneuvered into any agreement which allocates procurement. We will stress competitive procurement.

U. S. policy objectives in international armaments and defense logistics arrangements are based on and associated with other national objectives to:

- Encourage controlled disarmament.
- Avoid arms races.
- Tailor acquisitions of defense equipment to valid military requirements, available manpower capabilities, and competing social claims against national resources.

Within these constraints, the United States employs the whole battery of cooperative research and development, coproduction sales and competitive procurement from foreign sources with the following aims:

- To encourage increased allied defense capability—tempered by concern with the demands of economic development and political realities.
- To sell U.S.-produced defense equipment to free-world, financially capable buyers—tempered by a willingness to consider coproduction or licensed production abroad when sale seems precluded.
- To share U.S. technology with our allies so as to evoke their defense effort without incurring duplicative costs—tempered by the need to avoid a gratuitous weakening of the U.S. competitive position.
- To make first-line equipment available to our allies—tempered by a need to avoid uncompensated security risks of compromise.
- To be willing to procure selected defense equipment abroad for use by U.S. forces as part of large scale foreign purchase programs in the United States under competitive arrangements including participation by the United States when this nation can be assured of quality, cost, delivery and support terms equal to those obtainable from U.S. industry.
- To encourage the growth of an economically, politically and technologically strong North Atlantic Treaty Alliance—tempered by continuing attention to the effect of each action of logistics cooperation on other U.S. national objectives and on all sectors of the U.S. economy.

MAJOR MILITARY EQUIPMENT U. S. DEFENSE EXPENDITURES ABROAD ENTERING THE INTERNATIONAL BALANCE OF PAYMENT FISCAL YEARS 1962–1965 AND THE FIRST HALF OF FY 1966

($ Millions)

Region	FY 1962	FY 1963	FY 1964	FY 1965	Total FY 62–65	First Half FY 1966	Grand Total
EUROPE	73.1	73.1	57.7	62.9	266.8	22.4	289.2
NEAR EAST & SO. ASIA	1.9	1.0	.4	—	3.3	—	3.3
FAR EAST	54.8	52.2	25.2	4.5	136.7	2.0	138.7
AFRICA	.1	—	—	—	.1	—	.1
WESTERN HEMISPHERE	37.8	67.9	113.0	75.6	294.3	20.3	314.7
OTHER	.2	—	12.4	.3	12.9	2.2	15.1
GRAND TOTAL	167.9	194.2	208.7	143.3	714.1	46.9	761.0

As of 31 December 1965

Redesign Doubles Capability of Navy's Sub Rescue Vehicle

The U.S. Navy has redesigned its prototype submarine personnel rescue vehicle, known as the Deep Submergence Rescue Vehicle (DSRV), increasing the rescue capacity from 12 to 24 people.

Although the increase in rescue capacity adds about 5,000 pounds to the weight of the vehicle, it still retains its speed potential and air transportability. Two major advantages in the revised design are increased mission reliability by reducing equipment operation time, and increased crew survival time aboard a distressed submarine from 24 to 48 hours.

Increased crew life survival time aboard a distressed submarine is possible because the greater rescue capacity of the DSRV provides more space for greater amounts of oxygen and lithium hydroxide to be taken down and transferred to compartments within a stricken submarine.

Construction of the DSRV prototype will be completed and delivery made to the Navy in June 1968. The submersible will then become the first part of a "rescue mission system" to provide the Navy with a high probability of an on-the-scene submarine rescue capability anywhere in the world within a 24-hour period. By 1970 the Navy plans to have six DSRV's completed which will provide worldwide submarine rescue capability.

Lockheed Missiles and Space Co., Sunnyvale,Calif., is designing and will construct the prototype vehicles.

Army R&D Lab Evaluates Silent Power Turbine Unit

"Silent power" of a 3-kilowatt turbine unit is being evaluated by the Army Engineer R&D Laboratories, Fort Belvoir, Va. for possible use in forward areas.

The experimental mercury Rankine cycle power unit—inaudible at 100 meters—is one of three power sources with low-noise characteristics being studied by the Army.

The Rankine system consists of a burner, a mercury preheater and boiler, a mercury vapor turbine, air-cooled condenser, mercury-feed pump and controls. Production units would weigh less than 200 pounds.

The turbine is designed for 24,000 r.p.m. to drive a direct-connected alternator. The turbine-alternator-feed pump assembly is hermetically sealed with rotating components on a single shaft.

The model will run on any liquid hydrocarbon fuel including gasoline, "CITE," and JP-4.

AFSC Aerospace Medical Division Plays Key Role in Manned Flight Advances

by
Brig. Gen. Charles H. Roadman, USAF

On November 1, the Aerospace Medical Division (AMD) of the Air Force Systems Command will celebrate its fifth anniversary. The most important single fact about the Aerospace Medical Division is the breadth of its mission. When the division was formed in 1961, it was given the threefold responsibility for aerospace medical research and development, medical education and clinical medicine.

We perform research in support of aerospace systems development. We practice clinical medicine, primarily in support of aerospace operations, and we conduct teaching programs in the specialized techniques of aerospace medicine and its related disciplines. The philosophy behind this three-fold mission is that each facet of the total effort supports the other two. It provides a favorable climate for rapid advancement in medical knowledge with wide and prompt dissemination of new concepts into medical and operational practice. Medical research and development account for the largest part of our total effort. Roughly, 70 percent of our budget, our physical facilities and the talents of our professional and technical people are spent on research and development programs.

Clinical practice claims about 20 percent and the balance of 10 percent goes into medical education. Of course, there is a good deal of interchange in personnel and equipment between the three missions. The research people also do some teaching and they may participate in medical practice too, especially in connection with experimental programs. Clinical personnel also do research and teaching, and the teaching staff engage in medical practice and research.

The proportion of our total effort assigned to any one facet of the mission does not necessarily reflect the relative importance to the Air Force or to the nation. Our educational function, for example, is the prime source of trained specialists in aerospace medicine, not only for this country but for many of our allies. We have also trained most of the medical officials now with the airlines, in aerospace industries and with other Government agencies, such as the Federal Aviation Agency and the National Aeronautics and Space Administration (NASA).

From its headquarters at Brooks AFB, Tex., the Aerospace Medical Division commands, manages and plans for eight operating facilities at six geographical locations scattered as far away as Alaska and the Philippines. Each of these units has its own commander and their missions reflect the varied aspects of our AMD mission.

Wilford Hall USAF Hospital.

Wilford Hall USAF Hospital, located at Lackland AFB, Tex., is the prime clinical arm of the division. This 1000-bed facility serves as a base hospital for the Air Force's basic military training center, and receives complicated cases referred from all over the world. The hospital also contributes to our education mission by providing medical training in 18 specialty areas. It participates in our research and development program through its aerospace medical laboratory (clinical).

Aerospace Medical Research Laboratories.

The Aerospace Medical Research Laboratories at Wright-Patterson AFB, Ohio, conduct research in the fields of toxicology, biomechanics, human engineering and life support. Founded 32 years ago, primarily to design, fabricate and test new flying safety devices and systems for the protection of man in high speed aircraft, these laboratories now represent a capability in equipment and personnel not duplicated anywhere in the free world.

Brig. Gen. Charles H. Roadman, MC, USAF, is Commander of the Aerospace Medical Div., Brooks AFB, Tex. Gen. Roadman is a graduate of Northwestern University Medical School and a graduate of the Air Force School of Aviation Medicine. He is a Fellow of the Aerospace Medical Association and a member of the American Medical Association.

Aeromedical Research Laboratory.

At Holloman AFB, N.M., the division's Aeromedical Research Laboratory is the home of the largest trained research animal colony in the world. In addition to its work in impact studies, the laboratory trains Rhesus monkeys and chimpanzees to perform various discrete tasks. Baseline data is kept on the individual animals and on the species, thereby providing scientists with a good subject for use in those experiments not feasible for the human volunteer.

Arctic Aeromedical Laboratory.

Studies of human responses to the Arctic environment are carried out at AMD's Arctic Aeromedical Laboratory, which is located at Fort Wainwright, Alaska. In addition to testing cold weather survival equipment, this laboratory has been instrumental in the design and development of such survival equipment for aircrew members.

USAF Epidemiological Laboratory.

The division's Epidemiological Laboratory, located at Lackland AFB, is responsible for the investigation of epidemics any place in the world that might pose a threat to Air Force personnel. This organization was instrumental in preventing an epidemic of meningitis at Lackland AFB early this year. Early identification of the specific meningitis bacteria assisted the medical staff at Wilford Hall Hospital in treatment and enabled institution of early preventive measures that halted the epidemic. For the role it played in this, the organization received a citation from Headquarters, U. S. Air Force.

Fifth Epidemiological Flight.

A recent acquisition of the division is the Fifth Epidemiological Flight located at Clark Field, Philippines. Its mission includes the study and investigation of infectious diseases in the Far East and Southeast Asian areas.

USAF School of Aerospace Medicine.

The USAF School of Aerospace Medicine is collocated with the headquarters at Brooks AFB. The school got its start in 1917 as the Aviation Medicine Laboratory. The history and progress of aerospace medicine can be traced by the history and progress of the School of Aerospace Medicine.

In 1949, several years before Sputnik, the school organized the first department of space medicine in the free world. Since that time the school has played a key role in research in space

cabin atmospheres, radiation hazards, disorientation and a variety of other problems encountered in aerospace operations. The school conducts 30 courses in specialized training that vary in length from three days to three years.

The School of Aerospace Medicine has conducted the medical evaluation of the Air Force's aerospace test pilots, as well as all the NASA astronauts, except the seven Mercury astronauts. In addition, the school conducts a referral service for aircrew members whose flight status is questioned because of medical reasons. A thorough, detailed medical evaluation, which the school is capable of giving, has resulted in return to flying status of aircrew members who might otherwise have been grounded. During the past six years this has resulted in a potential savings to the taxpayer of over a quarter of a billion dollars in training costs.

In addition to specific achievements, the Aerospace Medical Division has made a concerted effort to support our forces in Southeast Asia (SEA). In addition to providing some of our best trained medical personnel to medical facilities in SEA, our research and development personnel have been responsible for a number of items in direct support of SEA.

To provide comfort to pilots flying in unventilated aircraft at low altitudes in tropical climates, our researchers adapted a rubberized vest circulating chilled water through tubes from an ice chest, using an electric pump. The vest weighs approximately three pounds and is worn under the flying suit. The weight of the entire unit for two men is less than 50 pounds, including 25 pounds of ice, and it occupies about one cubic foot of space. In a humid atmosphere at temperatures of 115 degrees Fahrenheit, it cools two men for a period of two hours.

Back in 1963 the human engineering people in our laboratories at Wright-Patterson AFB started working on a theory of lateral sighting techniques for aircraft. A modified gunsight was devised from this lateral firing concept and was tested in a C-47 aircraft. This led to the development of "Puff the Magic Dragon." These same laboratories also developed a Two Light Landing approach system for unimproved airfields, which is being tested in Vietnam at the present time.

Other developments now being evaluated include a litter rack system for air evacuation flights. This new development enables medical attendants to draw a litter from its normal flight position while a patient receives whatever care is needed. The litter then slides back and is locked in its regular place. An improved model of this system has been given static tests and is now being flight-tested in the C–141.

An outstanding example of systems-oriented work has been our research on habitable atmosphere for space cabins. These experiments have been performed both for NASA, validating the Gemini Apollo cabin environments, and for any Air Force extended space flight including the Manned Orbiting Laboratory.

Recent studies indicate that no untoward effects result from the use of an atmosphere composed of 70 percent oxygen and 30 percent helium at a pressure of five pounds per square inch. Earlier experiments had shown that an atmosphere of 100 percent oxygen at the same pressure could be tolerated for a period of at least 30 days. We are now able to offer the systems designer a choice of several cabin environments that will not impair the ability of the crew to function.

The possibility of damage to a spacecraft in flight has raised the question of emergency procedures after an explosive decompression. Our concern is not only with the time of useful consciousness, but more especially with the time available to save the crewman's life and to prevent permanent brain injury.

Chimpanzees, trained to perform discrete tasks, have been exposed to a near vacuum for as long as three and one-half minutes. After recompression and a four-hour interval for recovery, they performed at a level consistent with their capability before exposure. The exposure time of three and one-half minutes cannot be extrapolated directly to human beings. However, it does imply that full recovery is possible after a longer exposure than had been suggested previously.

In biomechanics, we study the effects of transient accelerations, vibrations and impact. Test equipment now in use includes drop towers, various other motion simulators and the horizontal track. In the past year, we have evaluated the F-111 restraint harness, the shifting center of gravity during simulated ejection from the Gemini B, and the vibration levels expected during flights of high-speed aircraft at very low altitudes.

In the next few months, the new Dynamic Escape Simulator should become fully operational at Wright-Patterson. This is really a complex motion simulator, with which we can generate acceleration forces together with vibration, changes in pressure and variations in temperature. We have examined these stresses individually for years. Now, for the first time, we can produce them in realistic combinations and sequences—as they are actually experienced in flight.

From the early days of aviation, components of the present Aerospace Medical Division have paralleled the extraordinary achievements of aircraft engineers in evolving high-speed, high-altitude flight systems by reconciling them with human needs and limitations. These advances have contributed significantly to the safety and comfort of passengers in modern jet transports. Since World War II the same progress has continued by extension to rocket aircraft and space vehicles. Eventually these innovations will be enjoyed routinely by travelers in supersonic transports, orbital gliders and inter-planetary spacecraft. The work that is going on within the Aerospace Medical Division today will play a key role in this development.

CALENDAR OF EVENTS

Sept. 22-23: Government-Industry Procurement Clinic, Seattle, Wash. Contact: Tom Hynes Jr., Dept. of Commerce & Economic Development, 312 First Ave. N., Seattle, Wash.

Sept. 24-Oct. 2: Greater Jackson Chamber of Commerce Midwest Space Fair, Jackson, Mich.

Sept. 26-28: Marine Systems Conference, Los Angeles, Calif.

Sept. 26-28: Sixth Annual National Conference on Environmental Effects on Aircraft and Propulsion Systems, Princeton, N.J.

Sept. 27: Industrial Procurement Conference, Oakland, Calif.

Sept. 27-30: American Roentgen Ray Society Meeting, San Francisco, Calif.

Sept. 28-29: National Security Industrial Assn. Marine Geodesy Symposium, Columbus, Ohio.

Sept. 30: Industrial Procurement Conference, San Bernardino, Calif.

Oct. 1-2: Akron-Canton Airport Aviation Days, Akron-Canton Airport, Ohio.

Oct. 2: Winston-Salem Jaycee Air Fair, Smith Reynolds Airport, Winston-Salem, N.C.

Oct. 2-14: Fourth Annual Research and Development Management Program, Battelle Memorial Institute (Ohio) and Ohio University, Columbus, Ohio.

Oct. 3-5: International Electronics Conference and Exhibition, McCormick Place, Chicago, Ill.

Oct. 3-5: Institute of Electrical and Electronics Engineers Aerospace and Electronics Convention, Washington, D.C.

Oct 4: Industrial Procurement Conference, Tucson, Ariz.

Oct 4: Industrial Procurement Conference, Marietta, Ohio.

Oct. 4-6: American Oil Chemists Society Meeting, Philadelphia, Pa.

Oct. 5-7: International Assn. of Electrical League Meeting, Scottsdale, Ariz.

Oct. 6: National Security Industrial Assn. Annual Meeting and Dinner, Washington, D.C.

Oct. 7: Industrial Procurement Conference, Albuquerque, N.M.

Oct. 7: Society of American Military Engineers Meeting, St. Paul, Minn.

Oct. 9-14: Electrochemical Society Meeting, Philadelphia, Pa.

Oct. 10-12: Assn. of the U.S. Army Meeting, Sheraton-Park Hotel, Washington, D.C.

Oct. 11-12: Air Techniques for Air Electronics Meeting, Washington, D.C.

Oct. 11-13: Armed Forces Management Assn. National Conference, Shoreham Hotel, Washington, D.C.

Oct. 17-21: American Society of Civil Engineers Meeting, Philadelphia, Pa.

Oct. 18-20: American Society of Mechanical Engineers Meeting, Minneapolis, Minn.

Oct. 19-21: Institute of Electrical and Electronics Engineers Meeting, Boston, Mass.

Oct. 25-26: Ninth Navy/Industry Conference on Material Reliability, Washington, D.C.

Oct. 27-28: Tulsa Chamber of Commerce Air Festival, Riverside Airport, Tulsa, Okla.

Oct. 31-Nov. 2: Defense Supply Assn. National Convention, Benjamin Franklin Hotel, Philadelphia, Pa.

Nov. 2: Industrial Management Society Meeting, Chicago, Ill.

Nov. 2-4: Northeast Electronic Research & Engineering Meeting, Boston, Mass.

Nov. 2-4: Air Force/National Security Industrial Assn. Meeting, Patrick AFB, Fla.

Nov. 8-10: Joint Computer Conference, San Francisco, Calif.

Nov. 9: National Security Industrial Assn. Meeting, Naval Ordnance Laboratory, Corona, Calif.

Nov. 14-16: American Petroleum Institute Meeting, New York City.

Nov. 15-17: Ships Control Systems Symposium, Annapolis, Md.

Nov. 17: Industrial Procurement Conference, Louisville, Ky.

Nov. 29-Dec. 2: American Institute of Aeronautics and Astronautics Annual Meeting and Technical Display, Boston, Mass.

DOD Procurement Conferences Under Way; Seattle Scene of Fifth Session

The fifth in a series of 14 DOD Procurement Conference Programs, scheduled for FY 1967 will be held in Seattle, Wash., Sept. 22-23, under the sponsorship of the Washington State Department of Commerce.

The conferences are designed to provide, in one location, a place for the businessman and potential contractor to become acquainted with the Federal procurement and contract process; to have practical individual discussions with specialists on business opportunities in the Army, Navy, Air Force and Defense Supply Agency; and to be counseled on surplus sales and the activities of the Defense Contract Administration Service, the Defense Documentation Center, and other Defense organizations concerned with prime contracting and subcontracting.

An item of special interest at the conferences will be the $30 to $40 million in current Invitations For Bids (IFB) and Requests For Proposals (RFP), including a number of "small purchase" ($2,500 and under) packages which will be on hand with Army, Navy, Air Force and DSA counselors.

In addition, DOD prime contractors from the area contiguous to the conference site will be on hand to discuss subcontract opportunities.

DOD will be joined in the procurement conferences by several other Federal agencies, including the Department of Commerce, the Small Business Administration, the National Aeronautics and Space Administration and the General Services Administration. In addition, the Atomic Energy Commission, Veterans Administration, Department of the Interior, Department of Agriculture and other agencies will participate in conferences in which there is an area of interest in their activities.

The Procurement Conference Program is part of DOD's continuing effort to develop additional competitive sources, large and small, to meet defense requirements. The first conference of this year's series was held in Lewiston, Maine. Others have been convened at Milwaukee, Wis.; Rochester, N.Y.; and Portland, Ore.

Subsequent conferences have been scheduled for the following dates and locations:

Sept. 27—Oakland, Calif.
Sept. 30—San Bernardino, Calif.
Allentown, Pa.
Oct. 4—Tucson, Ariz.
Marietta, Ohio
Oct. 5-6—Annapolis, Salisbury and Elkton, Md.
Oct. 7—Albuquerque, N.M.
Nov. 17—Louisville, Ky.

Reliability Requirements

(*Continued from Page 19*)

The aerospace industry working on Government negotiated contracts does not have precisely the same competitive environment. However, we have seen Government contracts provide bonus and penalty incentives to stimulate improved reliability. These dollar incentives are first felt by the stockholder and top level management of a company. The challenge and the opportunity is to find ways of extending these incentives to the designer, the engineer, and the worker who must build the quality into the hardware.

The aerospace industry gave birth to formalized programs designed to develop individual pride in workmanship. This concept has been adopted, fostered and encouraged by DOD. Most aerospace contractors today have instituted a formal Zero Defects Program. Evidence of substantial achievement has been recognized by the Air Force with its Zero Defects Achievement Award.

Once embarked on such a program, many contractors have applied imagination and resourcefulness to develop techniques of their own which will assist the worker to identify himself with the quality of his product and, thereby, achieve recognition for excellence of craftsmanship.

Value engineering is a concept which in its earliest application seemed to emphasize after-the-fact review of engineering design. After this concept takes root in aerospace companies, it must graduate to the stage where it is an essential element of the initial design process. The impact of automated data processing, computing, storage and retrieval has only begun to relieve designers and engineers of the mundane and time-consuming tasks, leaving their minds free for creative thought. The introduction of graphic display to computer storage and processing capability should soon enable a designer to prove on his drawing board what once took years of construction and test.

In our pursuit of 100 percent reliability, we must not overlook improvement of the tools which we now have. The need for hardware inspection will always be with us. Where it is less than perfect, redundancy will be necessary. We must, however, improve procedures, techniques, documentation and equipment. There is an endless need for non-destructive testing equipment not yet invented. Education and training of quality engineers and technicians must be revitalized and periodically updated. Industry, Government and professional organizations must work together in molding and developing these advances through the exchange of ideas, experiences and theories.

In the previous paragraphs, I have talked of some evolutionary improvements which must be made in the tools that we now use. I talked earlier of some new concepts which must be expanded and applied in new ways.

To achieve the consistent reliability needed to meet the very demanding requirements of future space ventures will not require a major breakthrough in the state of the art. If management in the aerospace industry can apply to these challenges the imagination and resourcefulness which have marked their past scientific and technical pioneering, there can be no doubt that the successes of Mercury and Gemini will be only the initial stepping stones in the exploration of our universe. Perhaps equally important will be the demonstration that our economy can afford to lead the world in space exploration without sacrifice of major objectives that are sorely needed to advance the standards of living here on earth.

Famed Radar Scientist Joins Army Electronics Command

Dr. Andrew Longacre, professor of engineering sciences at Syracuse University and a nationally famed radar scientist and inventor, has begun a tour as a visiting professor with the U.S. Army Electronics Command (ECOM), Fort Monmouth, N.J.

Dr. Longacre, longtime member and former chairman of the command's Electronic Advisory Group, is on sabbatical leave from Syracuse.

Long associated with radar research, and particularly noted for his work in side-looking radar, Dr. Longacre will devote his work at Fort Monmouth to radar and its application phases. He will be associated with Dr. Robert S. Wiseman, director of the CS-NV-TA Laboratories, and Victor L. Friedrich, deputy director and also a veteran radar researcher.

Dr. Longacre also will continue his duties as a member of the Electronics Advisory Group, comprising top-level electronic scientists, engineers and executives who provide advice and assistance to the commanding general of ECOM in the fulfillment of the command's missions.

Systems Analysis

(*Continued from Page 24*)

us, and an orderly, step-by-step improvement along these lines. I would expect that the best area for initial attention would be those new systems in which we do not have to press the technological state of the art too far, and whose eventual use is well understood and subject to quantitative analysis. But even in these cases, it might be wise, for a while, to retain certain of the classic parameters in the contract language as a hedge against the uncertainty surrounding the new technique.

I believe this is the direction in which we should move. Since both Government and industry are intimately involved, it is something we must work out together, and doing so requires an understanding of systems analysis techniques by both parties. Although the problems may be complex, the objective is simple: we would like to give you a better opportunity to exercise your talent and ingenuity in designing, developing and producing weapons that will better satisfy our real needs, rather than our arbitrary specifications.

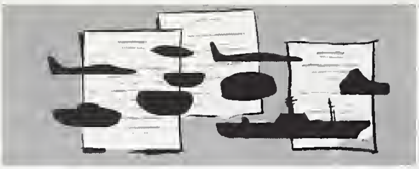
We feel confident that we have a powerful tool in systems analysis, and that it is reducing some of the inevitable uncertainty surrounding important decisions. However, we in the Office of the Secretary of Defense cannot assure single-handedly that the full benefits of quantitative analyysis will be realized in our national defense program. To do that requires the assistance of all concerned, and I trust that this brief account of our views will help to enlist industry's support.

European Command Headquarters Will Move to Germany

The Defense Department has announced that Headquarters, U.S. European Command, now located at Camp des Loges, France, will be transferred to Stuttgart, Germany.

The new location was chosen with the agreement of the Federal Republic of Germany and after the other North Atlantic Treaty Organization nations were informed.

Relocation of European Command headquarters is the second major step in DOD's program to rearrange and streamline the U.S. military command structure in Europe as a result of the necessity to relocate U.S. military forces from France.



DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of August 1966:

DEFENSE SUPPLY AGENCY

2—**Sinclair Refining Co.,** New York City, N.Y. $1,228,500. 12,600,000 gallons of JP-4 jet fuel. Defense Fuel Supply Center, Alexandria, Va.

3—**Formacroft Equipment Co.,** Pulaski, Va. $1,830,061. 300,000 coated nylon twill panchos. Pulaski. Defense Personnel Support Center, Philadelphia, Pa.

5—**Riegel Textile Corp.,** New York City, N.Y. $9,385,800. 18,500,000 square yds of cotton sateen cloth. Defense Personnel Support Center, Philadelphia, Pa.

—**J. P. Stevens & Co.,** New York City, N.Y. $2,024,756. 4,021,250 square yds of cotton sateen cloth. Defense Personnel Support Center, Philadelphia, Pa.

8—**Ames Textile Corp.,** Lowell, Mass. $1,452,600. 180,000 wool blankets. Defense Personnel Support Center, Philadelphia, Pa.

—**J. P. Stevens & Co.,** New York City, N.Y. $1,982,366. 200,000 wool blankets. Defense Personnel Support Center, Philadelphia, Pa.

—**Cleveland Woolens,** Cleveland, Tenn. $1,614,000. 200,000 wool blankets. Defense Personnel Support Center, Philadelphia, Pa.

—**Oscar Mayer & Co.,** Madison, Wis. $2,134,863. 5,644,800 5½-ounce cans of sliced cooked pork. Defense Personnel Support Center, Philadelphia, Pa.

—**Mobil Oil Corp.,** New York City, N.Y. $1,537,000. 900,000 barrels of Grade F.S. #6 burner fuel oil. Defense Fuel Supply Center, Alexandria, Va.

17—**State Industries,** Los Angeles, Calif. $6,313,687. 22,900 general purpose tents. Los Angeles. Defense Personnel Support Center, Philadelphia, Pa.

18—**Valley Metallurgical Processing Co.,** Essex, Conn. $1,566,500. 5,000,000 pounds of aluminum powder. Essex. Defense General Supply Center, Richmond, Va.

—**Aluminum Company of America,** Pittsburgh, Pa. $1,320,000. 4,000,000 pounds of aluminum powder. Pittsburgh. Defense General Supply Center, Richmond, Va.

19—**Howard Knit Products, Inc.,** Gastonia, N.C. $1,555,439. 2,931,648 men's white undershirts. Gastonia. Defense Personnel Support Center, Philadelphia, Pa.

—**Oregon Freeze Dry Food, Inc.,** Albany, Ore. $2,455,893. 1,890,000 subsistence packets. Albany. Defense Personnel Support Center, Philadelphia, Pa.

22—**Monsanto Co.,** St. Louis, Mo. $3,278,224. 529,600 gallons of herbicide. Defense General Supply Center, Richmond, Va.

23—**LaCrosse Garment Mfg. Co.,** LaCrosse, Wis. $1,321,250. Cotton duck tent shelter halves. LaCrosse. Defense Personnel Support Center Philadelphia, Pa.

—**Outboard Marine Corp.,** Waukegan, Ill. $1,049,916. 795 centrifugal pumps. Waukegan. Defense Construction Supply Center, Columbus, Ohio.

24—**King Wood Products,** East Elmhurst, N.Y. $2,910,040. 266,000 canvas folding cots. East Elmhurst. Defense General Supply Center, Richmond, Va.

25—**Cavalier Bag Co.,** Lumberton, N.C. $1,668,400. 10,000 packs of burlap sandbags and 62,000 packs of osnaburg sandbags. Defense General Supply Center, Richmond, Va.

—**Chase Bag Co.,** New York City, N.Y. $1,564,265. 23,000 packs of burlap sandbags and 48,250 packs of osnaburg sandbags. Defense General Supply Center, Richmond, Va.

> CONTRACT LEGEND
>
> Contract information is listed in the following sequence: Date—Company—Value—Material or work to be Performed—Location Work Performed — Contracting Agency.

—**Bemis Co.,** Minneapolis, Minn. $1,225,514. 2,000 packs of burlap sandbags and 48,976 packs of osnaburg sandbags. Defense General Supply Center, Richmond, Va.

—**Consolibag, Inc.,** Philadelphia, Pa. $1,018,050. 40,000 packs of burlap sandbags and 13,000 packs of osnaburg sandbags. Defense General Supply Center, Richmond, Va.

—**Peoples Co.,** Huntington, W.Va. $1,996,450. 10,200 small general purpose tents and 4,500 vestibule type, general purpose tents. Huntington. Defense Personnel Support Center, Philadelphia, Pa.

30—**West Point-Pepperel,** New York City, N.Y. $3,136,057. 2,417,000 yards of cotton duck cloth. New York City. Defense Personnel Support Center. Philadelphia, Pa.

ARMY

1—**General Motors,** Ypsilanti, Mich. $11,646,810. 20mm automatic guns to be used in aircraft. Ypsilanti. Army Weapons Command, Rock Island, Ill.

2—**Collins Radio Co.,** Addison, Tex. $1,000,000. Insulation provisioning kits for UH-1 helicopters. Addison. Navy Aviation Materiel Command, St. Louis, Mo.

—**Atlantic Research Corp.,** Alexandria, Va. $2,257,200. XM 2 canisters and XM 1 explosive opener assemblies for XM47 mines. Alexandria and Gainesville, Va. Picatinny Arsenal, Dover, N.J.

4—**Mason & Hanger—Silas Mason Co.,** Lexington, Ky. $3,479,535. Loading, assembling and packing 500 lb. bombs. Grand Island, Neb. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Great Lakes Dredge & Dock Co.,** Chicago, Ill. $4,289,000. Work on the Yaquina Bay & Harbor Project. Newport, Ore. Engineer Dist., Portland, Ore.

5—**Day & Zimmermann, Inc.,** Philadelphia, Pa. $21,154,859. Loading, assembling and packing miscellaneous medium caliber ammunition and components. Texarkana, Tex. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Atlantic Research Corp.,** West Hanover, Mass. $2,173,200. XM27 mines, and loading of XM2 canisters. West Hanover. Picatinny Arsenal, Dover, N.J.

—**New Orleans Stevedoring Co.,** New Orleans, La. $15,274,288. Stevedoring and related terminal services, Gulf Outport, New Orleans. Eastern Area, Military Traffic Management and Terminal Service, Brooklyn, N.Y.

—**American Machine & Foundry Co.,** Brooklyn, N.Y. $2,168,750. Fin assemblies for the 750 lb. bomb. St. Paul, Minn. Ammunition Procurement & Supply Agency. Joliet, Ill.

—**Consolidated Engineering Co.,** Baltimore, Md. $3,729,900. Construction of Officer Candidate School facilities consisting of 18 barracks, 1 mess hall, 9 administrative buildings, 4 classroom buildings, 2 instruction shops and an operation maintenance shop. Aberdeen Proving Grounds, Md. Engineer Dist., Baltimore, Md.

9—**Space Corp.,** Dallas, Tex. $5,174,944. Mobile floating assault bridge transporters. Garland, Tex. Army Mobility Equipment Center, St. Louis, Mo.

—**R. G. Le Tourneau, Inc.,** Longview, Tex. $2,078,125. Fin assemblies for the 750-lb bomb. Longview. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Cessna Aircraft,** Wichita, Kan. $2,150,000. M172E trainer aircraft, data, training and spare parts. Wichita. Army Aviation Materiel Command, St. Louis, Mo.

10—**Davis Construction Co.,** Memphis, Tenn. $1,443,000. Work on the Mississippi River and Tributaries — Channel Improvement Project. Engineer Dist., Memphis, Tenn.

—**Construction, Ltd.,** Bordentown, N.J. $1,234,567. Alterations and improvements to existing barracks and support facilities, and construction of new concrete masonry classrooms for expansion of military occupational specialist training facilities at Fort Monmouth, N.J. Engineer Dist., New York City, N.Y.

—**Brunswick Corp.,** Marion, Va. $3,693,849. Cartridge launchers. Sugar Grove, Va. Edgewood Arsenal, Md.

12—**Thomas Construction Co.,** St. Joseph, Mo. $2,154,600. Erection of prefabricated buildings at Fort Leonard Wood, Mo. Engineer Dist., Kansas City, Mo.

—**Gould National Batteries,** St. Paul, Minn. $1,221,326. 12-volt storage batteries for general use. Monroe, Mich. Army Tank Automotive Center, Warren, Mich.

15—**Admiral Corp.,** Chicago, Ill. $1,000,806. Various quantities of components for radio receiving sets (AN/ARC-54). Chicago. Army Electronics Command, Philadelphia, Pa.

—**Bethlehem Steel Corp.,** Bethlehem, Pa. $3,500,000. Gun tube forgings for the 175mm gun. Bethlehem. Watervliet Arsenal, N.Y.

—**Midvale Heppenstall Co.,** Philadelphia, Pa. $2,050,000. Tube forgings for the 175mm gun. Philadelphia. Watervliet Arsenal, N.Y.

—**Raytheon Co.,** Bedford, Mass. $2,500,000. Contract definition phase for the SAM-D surface-to-air missile system. Bedford, Mass., and Orlando, Fla. Army Missile Command, Huntsville, Ala.

—**Hughes Aircraft,** Fullerton, Calif., $3,024,532. SAM-D missile system. Fullerton, Santa Monica and San Jose, Calif. Army Missile Command, Huntsville, Ala.

—**RCA, Moorestown, N.J. $2,974,995.** Contract definition phase for the SAM-D missile system. Moorestown, N.J. and Wichita, Kan. Army Missile Command, Huntsville, Ala.

16—**General Motors, Delco Remy Div.,** Anderson, Ind. $2,143,420. 12-volt storage batteries. Anaheim, Calif. and New Brunswick, N.J. Army Tank Automotive Center, Warren, Mich.

—**Fifth West, Inc.,** Seattle, Wash. $1,044,500. Work on the Libby Dam Project. Near Libby, Mont. Engineer Dist., Seattle, Wash.

17—**AVCO Corp.,** Stratford, Conn. $1,245,599. Turbine rotor blades for T-53 engines for the UH-1 helicopter. Stratford. Army Aviation Materiel Command, St. Louis, Mo.

18—**Thiokol Chemical Corp.,** Bristol, Pa. $16,060,281. Loading, assembling and packing of miscellaneous illuminating shells and signals. Marshall, Tex. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Chamberlain Corp.,** Waterloo, Iowa. $1,598,170. Metal parts for the 2.75 inch rocket. Waterloo. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**L. T. Industries,** Garland, Tex. $1,988,382. Fin assemblies for 750-pound bombs. Garland. Ammunition Procurement & Supply Agency, Joliet, Ill.

19—**Raytheon Co.,** Lexington, Mass. $1,026,000. Metal parts for aerial bombs. Bristol, Tenn. Ammunition Procurement & Supply Agency, Joliet, Ill.

22—**General Motors,** Detroit, Mich. $21,566,188. Reactivation activities and production of 105mm projectiles at the St. Louis, Mo., Army Ammunition Plant. Ammunition Procurement & Supply Agency, Joliet, Ill.

23—**Independent Lock Co.,** Fitchburg, Mass. $1,005,552. Adapter boosters for aerial bombs. Fitchburg. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Morrison-Knudson Co.,** Boise, Idaho. $3,689,091. Work on the Lower Monumental Dam, Snake River Project. Near Pasco, Wash. Engineer Dist., Seattle, Wash.

—**Bell Helicopter Co.,** Fort Worth, Tex. $1,124,408. Rotor rudder blades for UH-1 helicopters. Fort Worth. Army Aviation Materiel Command, St. Louis, Mo.

—**Amron Corp.,** Waukesha, Wis. $5,405,353. 20mm brass cartridge cases. Waukesha. Frankford Arsenal, Philadelphia, Pa.

24—**Goodyear Tire & Rubber Co.,** Akron, Ohio. $1,963,685. Shoe assemblies for combat vehicles. Muncie, Ind. Army Tank Automotive Center, Warren, Mich.

—**Northrop Corp.,** Anaheim, Calif. $6,134,156. Hawk missile launchers. Anaheim.

Army Missile Command, Huntsville, Ala.

26—**Wilkenson Mfg. Co.**, Fort Calhoun, Neb. $1,127,237. 60mm cartridge fin assemblies. Fort Calhoun. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Eureka Williams Co.**, Bloomington, Ill. $7,183,679. 500- and 750-pound bomb components. Bloomington. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Control Data Corp.**, Bethesda, Md. $4,345,-758. Developing, designing, fabricating and testing of equipment necessary to provide an experimental automated Tactical Operations System. Palo Alto, Calif., Minneapolis, Minn. and in Germany. Army Electronics Command, Philadelphia, Pa.

—**Bergen Engineering Co.**, East Rutherford, N.J. $1,148,408. Construction of an ammunition development and engineering facility at Picatinny Arsenal, Dover, N.J. Engineer Dist., New York City, N.Y.

29—Remington Arms Co., Bridgeport, Conn. $26,994,303. Loading, assembling and packing of miscellaneous small arms ammunition and components. Lake City Army Ammunition Plant, Independence, Mo. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Martin Marietta**, Orlando, Fla. $2,623,609. Canisters. Orlando. Picatinny Arsenal, Dover, N.J.

—**Philco Corp.**, Newport Beach, Calif. $2,-310,000. Completion of development of XM30 helicopter armament sub-system. Newport Beach. Springfield Armory, Mass.

30—**Harvey Aluminum, Inc.**, Torrance, Calif. $1,580,000. Detonating fuzes. Torrance. Frankford Arsenal, Philadelphia, Pa.

—**Z. D. Products of Wells Marine, Inc.**, El Segundo, Calif. $1,104,040. Detnonating fuzes. El Segundo. Frankford Arsenal, Philadelphia, Pa.

31—**Hercules Powder Co.**, Wilmington, Del. $13,922,955. Loading, assembling and packing of miscellaneous propellants and explosives; and for operation and maintenance work. Radford Army Ammunition Plant, Radford, Va. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Union Carbide Corp.**, New York City, N.Y. $1,100,146. Dry batteries for a portable radio receiver. Greenville, N.C. Army Electronics Command, Philadelphia, Pa.

—**Quiller Construction Co.**, Los Angeles, Calif. $1,349,300. Construction of a one-story brick and stucco building at Norton AFB, Calif. Engineer Dist., Los Angeles, Calif.

—**Southwide Construction Co.**, Augusta, Ga. $1,010,850. Construction of ranges at the Army Training Center, Fort Bragg, N.C. Engineer Dist., Savannah, Ga.

—**Lawless and Alford, Inc.**, Austin, Tex. $4,465,013. Expansion of the Officer Candidate School at Fort Sill, Okla. Engineer Dist., Albuquerque, N.M.

—**Bermite Powder Co.**, Saugus, Calif. $2,-403,120. Fuze assemblies for 20mm cartridges. Saugus. Frankford Arsenal, Philadelphia, Pa.

—**Fairchild Camera and Instrument Corp.**, Paramus, N.J. $7,800,000. Countermeasure sets and miscellaneous items. Paramus. Army Electronics Command, Philadelphia, Pa.

—**Harvey Aluminum Co.**, Torrance, Calif. $1,738,000. 20mm projectiles. Torrance. Frankford Arsenal, Philadelphia, Pa.

—**Progressive Construction Co.**, Farmville, Va. $1,979,991. Construction of two buildings and rehabilitation of 42 buildings at the Army Training Center, Fort Bragg, N.C. Engineer Dist., Savannah, Ga.

NAVY

1—**Pacific Ship Repair, Inc.**, San Francisco, Calif. $1,276,000. Overhaul of the landing ship dock USS OAK HILL. San Francisco. Industrial Manager, 12th Naval District.

—**Ira S. Bushey & Sons**, Brooklyn, N.Y. $1,047,355. Regular overhaul of the auxiliary floating drydock (ARD-5). Brooklyn. Industrial Manager, 3rd Naval District.

—**Stanwick Corp.**, Washington, D.C. $1,-550,000. Development and evaluation of preventive maintenance standards for the Navy's Maintenance and Material Management System. $1,512,544. Development of techniques and systems design to permit analysis of reliability, maintainability and management data for the Navy's Maintenance and Material Management System. Washington, D.C. Naval Ship Systems Command.

2—**Lockheed Missiles & Space Co.**, Sunnyvale, Calif. $4,000,000. Research and development on the Polaris missile re-entry system. Sunnyvale. Special Projects Office.

—**United Aircraft, Pratt & Whitney Aircraft Div.**, East Hartford, Conn. $92,898,-600. TF30-P-3 engines for the Air Force. East Hartford. Naval Air Systems Command.

—**General Electric**, Schenectady, N.Y. $16,-805,800. Research and development work in the field of naval nuclear propulsion. Schenectady. Naval Ship Systems Command.

3—**Lockheed Missiles & Space Co.**, Sunnyvale, Calif. $21,600,000. Polaris A-3 missiles. Sunnyvale. Special Projects Office.

—**Raytheon Co., Submarines Signal Div.**, Portsmouth, R.I. $1,769,770. Providing instruction, material, services and testing of sonar equipment. Portsmouth. Naval Ship Systems Command.

—**General Electric**, Schenectady, N.Y. $16,-960,560. Furnishing of Navy nuclear propulsion components. Schenectady. Naval Ship Systems Command.

4—**North American Aviation, Autonetics Div.**, Anaheim, Calif. $1,068,822. Ships Inertial Navigation Systems equipment. Anaheim. Naval Ship Systems Command.

—**United Aircraft, Sikorsky Aircraft Div.**, Stratford, Conn. $1,981,904. Spare parts for SH-3D aircraft. Stratford. Navy Aviation Supply Office, Philadelphia, Pa.

5—**EDO Corp.**, Long Island, N.Y. $12,476,-751. Sonar equipment, College Point, L.I., N.Y. Naval Ship Systems Command.

—**United Aircraft, Pratt & Whitney Div.**, East Hartford, Conn. $8,500,000. Increased funding for Phase II development of the TF-30-P-12 engine. East Hartford Naval Air Systems Command.

—**Sanders Associates, Inc.**, Nashua, N.H. $1,840,907. Continued basic engineering and development of an air droppable ASW sonobuoy system. Nashua. Naval Air Systems Command.

—**Magnavox Co.**, Fort Wayne, Ind. $1,840,-907. Continued basic engineering and development of an air droppable ASW sonobuoy system. Fort Wayne. Naval Air Systems Command.

—**M. G. Allen & Associates**, Warwick, R.I. $1,096,000. Construction of a 600-foot antenna at the Naval Radio Station, Newport, R.I. and at the Naval Radio Station, Tarlac, Philippine Islands. Northeast Div., Naval Facilities Engineering Command.

—**Raytheon Co.**, Oxnard, Calif. $1,262,500. Services to fabricate and deliver turntable transmitters for the fire control system for the Sea Sparrow Project. Bedford, Mass. and Bristol, Tenn. Navy Purchasing Office, Los Angeles.

—**United Aircraft, Sikorsky Div.**, Stratford, Conn. $9,117,850. CH-53A helicopters. Stratford. Naval Air Systems Command.

8—**Westinghouse Electric**. Pittsburgh, Pa. $29,754,191. Navy nuclear propulsion components. Pittsburgh. Naval Ship Systems Command.

—**American Mfg. Co. of Texas**, Fort Worth, Tex. $1,693,600. Mark 41 projectiles for 5" 54 caliber guns. Fort Worth. Navy Ships Parts Control Center, Mechanicsburg, Pa.

—**LTV Aerospace Corp.**, Dallas, Tex. $3,-866,584. FY 67 procurement of A-7A Aircraft. Dallas. Naval Air Systems Command.

—**Westinghouse Electric**, Pittsburgh, Pa. $15,405,000. Research and development in the field of naval nuclear propulsion. West Mifflin Borough, Pa. Naval Ship Systems Command.

—**General Electric**, Washington, D.C. $1,-020,000. To establish a training program for the Poseidon Weapon System. Pittsfield, Mass. Special Projects Office.

9—**Norfolk Shipyard & Drydock Corp.**, Norfolk, Va. $1,805,333. Topside work involved in the regular overhaul of the oiler USS ELOKOMIN (AO-55). Norfolk. Industrial Manager, 5th Naval District.

—**Grumman Aircraft Engineering Corp.**, Bethpage, L.I., N. Y. $12,400,000. Research and development model EA-6B aircraft. Bethpage. Naval Air Systems Command.

—**McDonnell Aircraft**, St. Louis, Mo. $439,000,000. Procurement of F-4B, F-4D, F-4E, F-4J and RF-4C aircraft. St. Louis. Naval Air Systems Command.

—**Collins Radio Co.**, Cedar Rapids, Iowa. $2,493,421. Airborne UHF radio sets. Cedar Rapids. Naval Air Systems Command.

10—**Dow Chemical Co.**, Midland, Mich. $2,-090,550. Material for use in 2.75 inch rockets. Findlay, Ohio. Naval Propellant Plant, Indian Head, Md.

—**United Aircraft, Pratt & Whitney Div.**, East Hartford, Conn. $1,284,453. Spare parts to support J52P6/A/8 engines on F9F and F8 aircraft. East Hartford. Navy Aviation Supply Office, Philadelphia, Pa.

—**United Aircraft, Hamilton Standard Div.**, Windsor Locks, Conn. $2,680,871. Propeller system components for HC130H aircraft. Windsor Locks. Navy Aviation Supply Office, Philadelphia, Pa.

—**Sunstrand Corp.**, Rockford, Ill. $10,438,-860. Components for F-4 fighter aircraft. Rockford. Navy Purchasing Office, Washington, D.C.

11—**Kaman Aircraft Corp.**, Bloomfield Conn. $3,397,500. Conversion of UH-2A/B helicopters to a twin engine configuration designated UH-2C plus related equipment. Bloomfield. Naval Air Systems Command.

—**Straightline Mfg. Co.**, Cornwell Heights, Pa. $1,792,745. Fin assemblies for Mark 81 Mod 1 bombs. Cornwell Heights. Navy Ships Parts Control Center, Mechanicsburg, Pa.

—**Mills Mfg. Corp.**, Asheville, N.C. $1,204,-000. Parachute and container assemblies for Mark 24 flares. Asheville. Naval Ammunition Depot, Crane, Ind.

—**Gibbs & Cox.**, New York City, N.Y. $1,807,731. Contract design plans and specifications for a guided missile destroyer. Washington, D.C. Naval Ship Systems Command.

12—**General Electric**, Schenectady, N.Y. $13,-527,000. Furnishing of nuclear propulsion components. Schenectady. Naval Ship Systems Command.

—**American Shipbuilding Co.**, Lorain, Ohio. $4,718,605. Conversion of a maritime hull to a minesweeper special. Lorain. Naval Ship Systems Command.

15—**General Electric**, West Lynn, Mass. $2,-627,234. Spare parts for T58GE8B engines. West Lynn. Navy Aviation Supply Office, Philadelphia, Pa.

16—**Sperry Rand Corp.**, Syosset, L.I., N.Y. $13,392,000. FY 67 technical assistance in the Polaris inertial navigation subsystem program. Syosset. Naval Ship Systems Command.

—**Ryan Aeronautical Co.**, San Diego, Calif. $3,015,700. Firebee target drones. San Diego. Naval Air Systems Command.

—**DeLaval Turbine, Inc.**, Trenton, N.J. $5,283,720. Multi-year procurement of steam turbine generator sets, associated equipment and engineering support services. Trenton. Naval Ship Systems Command.

—**Beech Aircraft Corp.**, Wichita, Kan. $1,-704,201. AQM-37A aerial targets. Wichita. Naval Air Systems Command.

17—**Kelsey-Hayes Co.**, Philadelphia, Pa. $2,-079,107. Warheads for 2.75-inch rockets. Philadelphia. Navy Ships Parts Control Center, Mechanicsburg, Pa.

—**Sperry Rand Corp.**, Great Neck, L.I., N.Y. $8,945,321. Fire control radars for Terrier missiles. Great Neck. Naval Ordnance Systems Command.

—**United Aircraft**, Stratford, Conn. $3,500,-000. Long lead time effort and materials for HH-53B helicopters. Stratford. Naval Air Systems Command.

18—**Dell Industries**, Waycross, Ga. $5,770,203. Spare parts for 500-pound bombs. Waycross. Navy Ships Parts Control Center, Mechanicsburg, Pa.

—**Newport News Shipbuilding & Drydock Co.**, Newport News, Va. $21,955,000. Construction of an attack cargo ship. $36,-360,000. Construction of an amphibious force flagship. Newport News. Naval Ship Systems Command.

—**Avondale Shipyards**, New Orleans, La. $217,740,000. Construction of 20 ocean escort ships. New Orleans. Naval Ship Systems Command.

19—**Ministry of Defence, Navy Dept., United Kingdom.** $16,730,530. Construction of two surveying ships. Naval Ship Systems Command.

—**Ministry of Defence, Navy Dept., United Kingdom.** $7,354,850. Construction of a salvage tug. Naval Ship Systems Command.

—**Northwest Marine Iron Works**, Portland, Ore. $1,542,761. Modification and repair

of the missile range instrumentation ship USS WHEELING. Portland. Industrial Manager, 8th Naval District.

—**Vitro Corp. of America**, Silver Spring, Md. $1,458,250. Management services in connection with systems aboard surface ships. Silver Spring. Naval Ship Systems Command.

22—**Reeves Instrument Co.**, Garden City, L.I., N.Y. $10,168,215. Components of the Mark 68 fire control system. Garden City. Navy Purchasing Office, Washington, D.C.

—**Farmers Tool & Supply Corp.**, Denver, Colo. $2,376,000. Components of nozzle and fin assemblies for 2.75-inch rockets. Denver. Navy Ships Parts Control Center, Mechanicsburg, Pa.

23—**General Dynamics**, Pomona, Calif. $10,-325,000. Work on the standard missile. Pomona. Naval Ordnance Systems Command.

—**Peterson Builders**, Sturgeon Bay, Wis. $2,282,825. Construction of six patrol motor gunboats. Sturgeon Bay. Naval Ship Systems Command.

24—**Boeing Co.**, Morton, Pa. $9,637,378 and $13,243,000. Spare parts and rotor blades for CH-46 and UH-46 helicopters. Morton. Navy Aviation Supply Office, Philadelphia, Pa.

25—**Aerojet General Corp.**, Sacramento, Calif. $1,263,600. Rocket motors. Sacramento. Naval Ordnance Systems Command.

—**LTV Aerospace Corp.**, Dallas, Tex. $1,-142,655. Technical services and material to conduct aerial flights of target drones at Point Mugu, Calif. Naval Air Systems Command.

—**FMC Corp.**, San Jose, Calif. $2,545,124. Assembly and production of road wheels for LVTE1 amphibious vehicles. San Jose. Marine Corps.

26—**General Dynamics**, Pomona, Calif. $7,-500,000. Research and development on the standard missile. Pomona. Naval Air Systems Command.

—**United Aircraft**, Stratford, Conn. $11,-000,000. Long lead time effort and materials for CH-53A helicopters for the Marine Corps. Stratford. Naval Air Systems Command.

—**Johns Hopkins University, Applied Physics Laboratory**, Silver Spring, Md. $21,-987,960. Ordnance research, Silver Spring. Naval Ordnance Systems Command.

—**Rodale Electronics**, Garden City, N.Y. $1,364,734. Computers with weapon and aircraft adapters. Garden City. Naval Avionics Facility, Indianapolis, Ind.

—**Washington Aluminum Co.**, Baltimore, Md. $2,562,972. AM-2 mat assemblies for airfield matting. Enterprise, Ala. Naval Air Engineering Center, Philadelphia, Pa.

29—**Bendix Corp.**, Mishawaka, Ind. $1,418,000. Engineering and development program with associated production and tactical test equipment of the Talos missile. Mishawaka. Naval Ordnance Systems Command.

—**Southern Shipbuilding Corp.**, Slidell, La. $1,542,168. Construction of two landing craft, utility (LCU). Slidell. Naval Ship Systems Command.

30—**New York Shipbuilding Corp.**, Camden, N.J. $1,226,273. Regular overhaul of the store ship USS DENEBOLA (AF-56). Camden. Industrial Manager, 5th Naval District.

—**Pacific Ship Repair Co.**, San Francisco, Calif. $1,533,650. Overhaul work on the aircraft ferry USNS POINT CRUZ. San Francisco. Military Sea Transportation Service.

—**United Aircraft**, Windsor Locks, Conn. $4,000,000. Propeller systems for installation on P-3B aircraft. Windsor Locks. Navy Aviation Supply Office, Philadelphia, Pa.

—**Ward LaFrance Trucks Corp.**, Elmira Heights, N.Y. $1,094,700. Aircraft towing tractors. Elmira Heights. Navy Purchasing Office, Washington, D.C.

31—**Grumman Aircraft Engineering Corp.**, Bethpage, N.Y. $5,917,350. FY 66 procurement of A6A aircraft. Naval Air Systems Command.

—**Magnavox Co.**, Fort Wayne, Ind. $1,627,-733. Design review, development, fabrication and test of preproduction models of an electronic countermeasure system; and to conduct liaison engineering for the program. Fort Wayne. Naval Air Systems Command.

—**Ratheon Co.**, Bedford, Mass. $1,797,178. Research and development on the Sparrow missile. Bedford. Naval Air Systems Command.

—**General Dynamics**, Rochester, N.Y. $1,-771,832. Components for aircraft radio receiver sets. Rochester. Navy Aviation Supply Office, Philadelphia, Pa.

—**Bethlehem Steel Co.**, Hoboken, N.J. $1,-062,301. Regular overhaul of the ammunition ship USS GREAT SITKIN (AE-17). Hoboken, Industrial Manager, 3rd Naval District.

AIR FORCE

1—**RCA**, Princeton, N.J. $4,450,000. Production of communication and electronic components for space satellites. Princeton. Space Systems Div., (AFSC), Los Angeles, Calif.

—**Barnes Engineering Co.**, Stamford, Conn. $1,575,000. Production of horizon sensor radar systems. Stamford. Space Systems Div., (AFSC), Los Angeles, Calif.

3—**Fairchild Hiller Corp.**, St. Augustine, Fla. $1,570,678. Repair of C-119 aircraft. St. Augustine. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga.

—**United Aircraft**, East Hartford, Conn. $2,880,101. Production of spare parts for the J-57 aircraft engine. East Hartford. Kelly AFB, Tex.

—**General Motors**, Indianapolis, Ind. $5,551,-101. Production of T-56 aircraft engines and related equipment. Indianapolis. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio.

—**Boeing Co.**, Wichita, Kan. $1,936,687. Kits for B-52 wing and body structural modification. Wichita. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla.

—**Curtiss Wright Corp.**, Wood-Ridge, N.J. $1,091,918. Overhaul of J-65 aircraft engines. Wood-Ridge, Kelly AFB, Tex.

4—**Northrup Corp.**, Anaheim, Calif. $4,500,-000. Production of aircraft rocket warheads. Anaheim. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio.

—**Hughes Aircraft**, Culver City, Calif. $2,-952,000. Work on an air-to-surface missile guidance program. Culver City. Systems Engineering Group, Wright-Patterson AFB, Ohio.

—**Aerodex, Inc.**, Miami, Fla. $2,427,105. Overhaul of J-57 aircraft engines. Miami. Kelly AFB, Tex.

—**IBM**, Washington, D.C. $5,751,634. Purchase of leased computer systems. 2750th Air Base Wing, Wright-Patterson AFB, Ohio.

—**Thompson-Ramo-Woolridge, Inc.**, Redondo Beach, Calif. $1,403,700. Work on a space program. Redondo Beach. Space Systems Div., (AFSC), Los Angeles.

—**Aerojet-General Corp.**, Sacramento, Calif. $2,000,000. Research, development and production of realigned stage III Minuteman III motors. Sacramento. Ballistic Systems Div., (AFSC), Norton AFB, Calif.

5—**Aerojet-General Corp.**, Sacramento, Calif. $5,225,000. Overhaul, test and analytical services in support of the TITAN II propulsion engine system. Sacramento. Ogden Air Material Area, (AFLC), Hill AFB, Utah.

—**Aviation Investments, Inc.**, Miami, Fla. $1,072,439. Inspection and repair of C-47 aircraft. Miami. Warner-Robins Air Materiel Area, (AFSC), Robins AFB, Ga.

—**General Motors**, Milwaukee, Wis. $1,300,-000. Work on an inertial guidance system. Milwaukee. Space Systems Div., (AFSC), Los Angeles, Calif.

—**Magnavox Co.**, Fort Wayne, Ind. $1,297,-112. Production of aircraft communication sets. Fort Wayne. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio.

—**Sperry Rand Corp.**, Washington, D.C. $1,910,380. Computer systems. Utica, N.Y. Wright-Patterson AFB, Ohio.

—**Bendix Corp.**, Ann Arbor, Mich. $2,172,-000. Production of a communication system. Ann Arbor. Electronic Systems Div., (AFSC), L. G. Hanscom Field, Mass.

8—**American Bosch Arma Corp.**, Garden City, N.Y. $1,500,000. Support services for the Advanced Ballistic Re-entry System program. Garden City. Ballistic Systems Div., (AFSC), Norton AFB, Calif.

—**Cleveland Pneumatic Tool Co.**, Cleveland, Ohio. $1,567,128. Production of landing gear components for F-4 aircraft. Cleveland. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah.

—**Lear Siegler, Inc.**, Grand Rapids, Mich. $1,190,488. Aircraft navigation and bombing computer sets for F-4 aircraft. Grand Rapids. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio.

9—**Federal Electric Corp.**, Paramus, N.J. $2,905,475. Management and operation of the Air Force Western Test Range, Vandenberg AFB, Calif. Air Force Western Test Range.

—**General Precision, Inc.**, Pleasantville, N.Y. $1,643,048. Advanced manned strategic aircraft Doppler Radar Program. Pleasantville. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio.

—**North American Aviation, Inc., Anaheim**, Calif. $4,625,000. Maintenance and modification of Minuteman missile guidance and control equipment. Anaheim. Ballistics Systems Div., (AFSC), Norton AFB, Calif.

10—**Douglas Aircraft**, Santa Monica, Calif. $1,196,668. Procurement of Genie rocket motors. Rancho Cordova, Calif. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah.

—**General Dynamics, Convair Div.**, San Diego, Calif. $1,753,000. Launch services in support of Atlas-Agena Space programs. San Diego. Space Systems Div., (AFSC), Los Angeles, Calif.

11—**North American Aviation**, Los Angeles, Calif. $1,381,316. Modification of T-39 aircraft, Los Angeles. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif.

—**Sanders Associates**, Nasau, N.H. $1,363,-701. Production of airborne radio direction finding equipment. Nashua. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio.

—**United Aircraft**, East Hartford, Conn. $3,781,658. Spare parts for J-57 aircraft engines. East Hartford. Kelly AFB, Tex.

12—**North American Aviation, Autonetics Div.**, Anaheim, Calif. $10,254,000. Design and development of post-boost control systems for the Minuteman Missile. Anaheim. Ballistic Systems Div., (AFSC), Norton AFB, Calif.

—**B. F. Goodrich Co.**, Akron, Ohio. $1,402,-290. Procurement of F-4 aircraft tires. Akron. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah.

—**Douglas Aircraft**, Long Beach, Calif. $1,043,000. To conduct fatigue tests on C-124 aircraft. Long Beach. Warner Robins Air Materiel Area (AFLC), Robins AFB, Ga.

—**Raytheon Co.**, Bedford, Mass. $1,400,000. Work on an advanced airborne overland radar system. Bedford. Research and Technology Div., Wright-Patterson AFB, Ohio.

—**General Motors**, Indianapolis, Ind. $1,-338,823. Procurement of turbine blades for T-56 engines. Indianapolis. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla.

15—**Aerojet-General Corp.**, Sacramento, Calif. $1,100,000. Design of an advanced post launch propulsion system for balllistic missiles. Sacramento. Air Force Flight Test Center, (AFSC), Edwards AFB, Calif.

16—**Gary Aircraft Corp.**, San Antonio, Tex. $1,602,292. Overhaul of Packette Aerospace Ground Equipment Engines and related parts and accessories. Hondo, Tex. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex.

—**General Dynamics**, San Diego, Calif. $5,-723,878. Work on design and development of a standard space launch vehicle. San Diego. Space Systems Div., (AFSC), Los Angeles, Calif.

—**Hercules, Inc.**, Wilmington, Del. $20,-313,000. Production of Stage III motors for Minuteman II missiles. Magna, Utah. Ballistic Systems Div., (AFSC), Norton AFB, Calif.

17—**Aero Corp.**, Lake City, Fla. $3,225,000. Inspection and repair of C-124 aircraft. Lake City. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga.

—**Systems Development Corp.**, Santa Monica, Calif. $1,400,000. Research and laboratory work on information processing techniques program. Santa Monica. Electronic Systems Div., (AFSC), L. G. Hanscom Field, Mass.

18—**North American Aviation**, Los Angeles, Calif. $1,000,000. Engineering, technical and support services for the X-15 research aircraft program. Los Angeles. Aeronau-

tical Systems Div., (AFSC), Wright-Patterson AFB, Ohio.

19—**Motorola, Inc.,** Scottsdale, Ariz. $1,137,600. X-band communication sets. Scottsdale. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla.

—**Boeing Co.,** Wichita, Kan. $4,100,000. Modification kits for B-52 aircraft. Wichita. Oklahoma City ir Materiel Area, (AFLC), Tinker AFB, Okla.

—**B. F. Goodrich Co.,** Akron, Ohio. $1,720,510. Tire tubes for C-130 aircraft. Akron. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah.

—**Hayer International Corp.,** Birmingham, Ala. $4,758,438. Inspection and repair as necessary of C-124 aircraft. Birmingham. Warner-Robins Air Materiel Area, (AFLC), Robins AFB, Ga.

—**United Aircraft,** East Hartford, Conn. $1,473,620. Production of components for J-57, T-34 and TF-33 aircraft engines. East Hartford. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex.

22—**Boeing Co.,** Seattle, Wash. $50,824,000. Production of Minuteman II missiles and related equipment. Seattle. Ballistic Systems Div., (AFSC), Norton AFB, Calif.

—**General Motors,** Indianapolis, Ind. $1,261,214. Turbine blades for T-56 engines. Indianapolis. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla.

—**United Aircraft,** East Hartford, Conn. $2,933,490. Production of aircraft engine components. East Hartford. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex.

—**Cessna Aircraft,** Wichita, Kan. $3,500,000. Modification of T-37 aircraft to AT-37 configuration. Wichita. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio.

23—**United Aircraft,** East Hartford, Conn. $1,107,487. Production of spare parts for the J-57 aircraft engine. East Hartford. San Antonio Air Materiel Avea, (AFLC), Kelly AFB, Tex.

—**Boeing Co.,** Wichita, Kan. $2,681,444. FY 67 engineering and support services for the B-52 fleet. Wichita. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla.

—**Hughes Aircraft,** Fullerton, Calif. $1,200,000. Development of overland radar techniques. Fullerton. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio.

24—**M.I.T.,** Cambridge, Mass. $1,200,000. Work on an advanced sensor program. Cambridge, Systems Engineering Group, (AFSC), Wright-Patterson, AFB, Ohio.

—**M.I.T.,** Cambridge, Mass. $28,790,000. Research and development on advanced electronic programs. Lexington, Mass. Electronic Systems Div., (AFSC), L. G. Hanscom Field, Mass.

25—**United Aircraft,** Windsor Locks, Conn. $1,581,957. Overhaul and modification of aircraft propellers. East Granby, Conn. Warner-Robins Air Materiel Area, (AFLC), Robins AFB, Ga.

26—**Analytical Services, Inc.,** Falls Church, Va. $1,340,000. Analytical studies pertaining to the application of weapons systems. Falls Church. Air Force Office of Scientific Research.

—**Continental Aviation and Engineering Corp.,** Detroit, Mich. $1,050,000. Work on an advanced turbine gas generator program. Detroit. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio.

30—**System Development Corp.,** Santa Monica, Calif. $14,696,032. Design and development of electronic information and communications equipment. Santa Monica. Electronic Systems Div., (AFSC), L. G. Hanscom Field, Mass.

—**Hughes Aircraft,** Culver City, Calif. $16,786,006. Conversion of AIM-4C to AIM-4D (Falcon) aircraft missiles. Tucson, Ariz. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga.

—**Stewart & Stevenson Services, Inc.,** Houston, Tex. $1,281,423. Production of heavy duty electrical generators. Houston, Tex. Sacramento Air Materiel Area, (AFLC), Kelly AFB, Tex.

31—**United Aircraft,** East Hartford, Conn. $1,516,313. Production of components for J-57 and T-34 aircraft engines. East Hartford. San Antonio Air Materiel Area, (AFLC), Kelly FB, Tex.

—**The City of Grand Forks, N.D.** $1,730,000. Increased water supply at Grand Forks AFB, N.D. Grand Forks AFB Procurement Office.

USAF Invites 15 Firms To Submit Proposals for Computer Systems

Fifteen computer manufacturers have been invited by the Electronic Systems Div., Air Force Systems Command, L. G. Hanscom Field, Mass., to submit proposals for installing 100 to 160 electronic data processing systems at Air Force bases throughout the world.

The firms were given until Nov. 30 to submit their proposals to the Electronic Data Processing (EDP) Equipment Office at Electronic Systems Div., in what is expected to be the largest single acquisition of commercially available computers ever undertaken.

The equipment represents the second phase of the Base Level Data Automation Standardization Program.

Colonel S. P. Steffes, head of the EDP Equipment Office, has suggested that small business firms, or others interested in sub-contracting opportunities in connection with this program, make direct contact with the firms invited to submit proposals.

The fifteen invited companies are: Burroughs Corps., Collins Radio, Computer Control Co., Control Data Corp., Friden Inc., General Electric, General Precision, Honeywell, I.B.M., Lear-Siegler, National Cash Register, Philco, R.C.A., Scientific Data Systems and Sperry Rand.

Evaluation of proposals and selection will be done according to standard Air Force selection procedures. Acquisition of equipment will be made under existing General Service Administration schedules.

New Security Manual Available to Industry

The latest edition of the Industrial Security Manual for Safeguarding Classified Information (ISM) has been distributed by the Defense Supply Agency and is now available for purchase.

Copies of the new manual can be ordered from the U.S. Government Printing Office, Washington, D.C., 20402 for $1.50. Order by Catalog Number: D3.6/3:SE 2/966.

The manual establishes uniform security practices within industrial plants or education institutions and all organizations and facilities used by prime and subcontractors having classified information of the Defense Department.

Because of the variety and scope of revisions, a resume of the changes has been prepared as an introduction to the new manual.

Contractors should begin revising their Standard Practice Procedures (SPP) so that the revised SPP will reach the cognizant security office by November 1966.

Nuclear Vulnerability Assessment Responsibility Assigned to AFSWC

Responsibility for assessing the vulnerability of operational weapon systems to the effects of nuclear explosions has been assigned to the Air Force Special Weapons Center (AFSWC) at Kirtland AFB, N. M., by the Air Force Systems Command. The center, commanded by Colonel Ralph S. Garman, has conducted laboratory and field tests to simulate the effects of nuclear explosions for several years.

A new office has been established under the center's Deputy for Test and Engineering. This office will analyze and, if necessary, test under simulated conditions the ability of operational Air Force aircraft and missiles to survive and operate in wartime nuclear environments. It will conduct vulnerability assessments on a continuous basis in light of new nuclear effects knowledge gained from underground tests, theoretical studies and effects simulation tests.

The Systems Command's Air Force Weapons Laboratory, also located at Kirtland AFB, will continue its development of new simulation techniques for AFSWC and will support the center with effects data and computer services.

Contractor's Training Guide Available

A publication titled, "Contractor's Training Manual," which is a sectionalized compilation of the individual specialized training requirements of the Army, Navy, Air Force and the National Aeronautics and Space Administration, has been released by the Aerospace Industries Association (AIA). It was prepared by task groups of industry training management specialists under the cognizance of the AIA Product Support Committee.

The manual is a complete set of guidelines, in one volume, from which the criteria governing hardware and personnel training requirements can be established. It can aid in the preparation of training proposals, and it can be of particular assistance in the final formation of complete training programs.

It is intended that the manual will benefit all organizations, both large and small, including the experienced contractor who may find it necessary to reorient his organization to a new customer and a changed requirement that is beyond his existing experience.

Copies of the manual, in limited quantities, are available at $5.00 each. Requests should be forwarded to:

Aerospace Industries Association
1725 DeSales St. NW
Washington, D.C. 20036

OFFICE OF THE SECRETARY OF DEFENSE
WASHINGTON, D. C. 20301

OFFICIAL BUSINESS

Military Kept Moving During Airline Strike by MTMTS/Labor Cooperation

When five major airlines were idled by a strike July 8, knocking out more than 60 percent of the nation's air-passenger capacity, movement of military personnel had to go right on, uninterrupted.

For the Armed Forces it was a particularly bad time for a transportation tieup. In addition to normal traffic, thousands of reservists were on the move in connection with annual two-week summer training sessions. Since arrangements are made well in advance of movement dates, much administrative reshuffling was needed.

With no added personnel, the Military Traffic Management and Terminal Service (MTMTS) began 24-hour operations in an attempt to resolve the problem.

About July 1, actions were taken to reroute Defense group-movements scheduled on the affected airlines for July 6, 7 and 8—the 6th being the earliest date the strike could legally be called.

On July 5, Major General John J. Lane, MTMTS commander, alerted his nationwide command, and the Military Services, for carrying out the terms of the emergency transportation plan.

A member of his staff, meanwhile, met with representatives of the Secretary of Defense to prepare memoranda which described the impact of the strike on national defense, and the means by which remaining commercial transportation could be used.

MTMTS gained a concession from the striking union whereby charters within the continental United States would be permitted to operate for essential military traffic. This would accommodate about 30,000 military passengers a month who ordinarily would use the affected lines.

Throughout the strike MTMTS worked closely with the Air Transport Association and other groups from the industry. All group-movement personnel scheduled on the five struck carriers were rerouted and moved without delay. Local transportation officers rounded up individuals and small groups and consolidated them into groups of 15 or more, thereby enabling MTMTS to charter flights. This action prevented individual military travelers from being stranded while journeying to new duty assignments. or home on leave. Consolidation efforts by MTMTS and the cooperation of the striking union solved the problem thereby averting a situation which could have been detrimental to national defense.

Navy Aquanauts Get Permanent Home in San Diego

A permanent home port and training facilities for Navy aquanauts assigned to the Man-in-the-Sea program has been activated in San Diego, Calif.

The aquanaut base, called the Deep Submergence Systems Project Technical Office (DSS PTO), is located at the Submarine Support Facility, Ballast Point, San Diego.

The technical office provides curricula, schedules and facilities for training Navy aquanauts. In addition, the new office will furnish engineering, research, testing and technical services for specific Navy operational requirements, and give assistance during implementation of ocean engineering experiments involving performance evaluation of ocean engineering hardware, such as diving suits and air breathing equipment for divers.

It is estimated that complete diver training in all aspects of advanced diving techniques will be available at the new office in about 18 months.

Capt. Walter F. Mazzone, MC, who served as physiological control officer during both of the Navy's SEALAB experiments, has been named Officer-in-Charge of the new aquanaut center. The office will be staffed by 15 officers and 43 enlisted men.